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Welcome

Custom PC Issue 225

/ FROM THE EDITOR

Water works

What's the point of water cooling? The thermal benefits aren't that important in a world where manually overclocking a 16-core CPU is largely pointless, and AMD's latest gaming CPUs don't even have unlocked multipliers (see p12). Custom water-cooling loops can be very quiet, of course, but so can a PC kitted out with decent Noctua air-cooling gear, such as the Gladiator Nocturnal on p36.

That misses the point though. Of course you don't *need* a PC with a custom water-cooling loop, just like you don't *need* a fancy Swiss watch, a sports car or a fitted kitchen with a range cooker. That doesn't prevent them from being very nice to have though. Let's face it, water-cooled PCs look gorgeous, and there's nothing wrong with spending both time and money on making a PC that's not only super-cool and quiet, but also looks amazing.

Building a water-cooled PC also presents fun engineering challenges to overcome, and if you can afford the gear, it makes for a great project to set yourself. It's not easy, though, especially if you've not done it before. That's why we've devoted this issue's lead feature to the process of building a water-cooled PC – not because it's necessary, but because it's a challenging project that gives you a lovely result at the end.

We've done general introductory guides to water cooling before, but this time we wanted to take you through the whole process with a specific set of components, with full details of the gear you need, how to hook it up and where to place it. Not only that, but we've also used hard tubing, with instructions on how to measure, cut and bend it.

If you buy all the gear outlined in our feature on p78, then you'll be able to do it too. You can use your own choice of SSD, memory, Alder Lake CPU, graphics card and PSU, but if you stick with our choice of water-cooling gear, case and motherboard, you'll have all the information you need to build a PC that looks just like the one on the front cover.

If you've never tried water-cooling a PC before, but you've always fancied having a go, here's a great opportunity to follow our guide and get started. CPC

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CUSTOM PC

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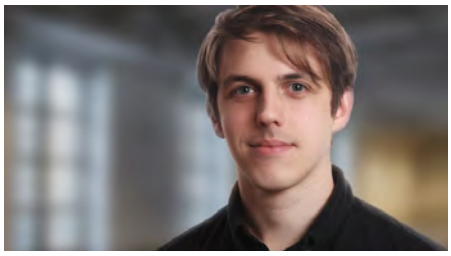

RICHARD SWINBURNE / VIEW FROM TAIWAN

INTEL'S AMBITION GROWS

Intel is planning an avalanche of new nodes and chips over the next couple of years. Richard Swinburne takes a look at the latest information

At its recent Investor Day Conference, Intel issued an updated foundry road map for its upcoming releases with a few minor, yet eyebrow-raising, changes since its last one. Last year, Intel committed to accelerating its process nodes, with the aim to make the world's smallest transistors by 2025. To say it was ambitious puts it lightly – if Intel pulls it off, it would be an incredible turnaround, the likes of which hasn't been seen since it dumped Netburst and pivoted to the Core architecture in 2006.

Intel is already shipping silicon made using its 'Intel 7-don't-call-it-nanometer' process, including its Alder Lake CPUs. Next up, 'Intel 4' is due in the second half of this year, which will be followed by 'Intel 3' next year in 2023. A 12-month cadence is quite ambitious, but doable, as shown by TSMC and Samsung.

As we hit 2024 it then gets really ambitious, with 'Intel 20A' (A for 'Angstrom') arriving six months after 'Intel 3' in the first half of 2024, then 'Intel 18A' follows within another six months in the second half of 2024. Last year, Intel had its 18A process originally pencilled in for 2025, but now it's saying 2024 – at the event Intel noted it had already delivered test chips based on its 18A process to customers, and was expecting more chip tape outs to follow this year.

> To say it was ambitious puts it lightly

Come 2024, the CPU market is going to get really interesting. This year, though, there's a smidge of disappointment, as the event also issued an update on Intel's forthcoming 13th-gen Raptor Lake CPUs, which will be hitting stores in October/November this year. Intel revealed it's adding a load more cores for its top-end chips – up from 16 to 24, with 32 threads, which means there's another block of eight E-Cores being added.

For that, Intel noted the top chip would offer up to a 'double-digit performance boost' over its predecessor, which in my experience is usually marketing speak for 10 per cent. Eight more cores for a 10 per cent gain? If that's the case, there must be some information missing.

There are no expected power efficiency gains on offer either, as 13th-gen CPUs are still made on the current 'Intel 7' process used by Alder Lake. If you already own a 12th-gen system, it looks as though you've made a good investment.

Meanwhile, the 14th-gen Meteor Lake and 15th-gen Arrow Lake desktop platforms arrive in 2023 and 2024 respectively. Meteor Lake is Intel's first-generation tiled (multi-chip) design, where the CPU, SoC/IO and GPU are disaggregated into three separate dies and connected via EMIB bridges. At this time, we suspect only the CPU die will use 'Intel 4' (a year after that process is formally introduced), while the GPU will likely be made at TSMC, not Intel. The SoC/IO die may continue to use the older 'Intel 7' process to benefit from yield and cost advantages.

Since CEO Pat Gelsinger issued the first foundry process road map last year, analysts have openly wondered if he can actually deliver on his promises. Given its extended time at 14nm and multi-year problems at 10nm, those doubts are justified, yet news of real chips and road map acceleration are very encouraging.

However, some questions still remain, such as what capacity and yield will we see with each new process, and what products will use them? Intel is, after all, also a foundry for third-party customers now, so these factors will be crucial to compete with TSMC and Samsung. 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

WAR GAMES

Tracy King considers the role and impact of games that simulate war in light of current events

Games are escapism, even when the game is realistic or a simulator of one of the very things we're playing to escape. Gaming Tracy is good at everything, with enough practice. I'm a skilled driver and farmer, a world-class footballer. I can jump really high and figure out puzzles to open magic doors, shortly before dispatching whatever lies behind it with my sword or gun (equally proficient with both). If I mess up, I load a save game, or go and grind some more, no sweat. I will, eventually, win.

Games let us do anything and be anyone, which is great for stress relief. But up until now, war hasn't been an everyday stress for a lot of us in the West, and now almost overnight, the media is talking about nukes and World War III as if we're not still busy in our pandemic bunkers.

Games that depict war suddenly have a different vibe. Russia, one of the goodies in WWII, are the baddies, while Sweden and Switzerland have dropped neutrality in favour of Ukraine. Who is depicted as killing whom in games is now extra fraught, leading to Nintendo indefinitely postponing the release of Advance Wars 1+2:Re-Boot Camp because the Blue Moon faction in the game is basically Russia. Plus, the whole 'war' theme is maybe a little too on the nose for such a family-orientated company.

Meanwhile, 2014 indie game This War of Mine, which presents an invasion from the point of view of civilians, has seen a huge surge in popularity leading to the developer, 11 Bit, donating all new profits to the Red Cross in Ukraine. Clearly, empathy is both important and, judging by the sales, popular. But on the flip side, in a realistic battle simulator (just like real war), someone has to be the baddie. Someone has to be acceptable to kill, and not everyone is okay with the implications of that.

> Empathy is both important and, judging by the sales, popular

It's not a new issue, and it's been raised by people from ethnicities, countries or religions often depicted as the bad guys. Game developer Rami Ismael of Vlambeer, who is Dutch and practises the Muslim faith, has tweeted often about it. In 2021, he said of Six Days in Fallujah, 'I cannot summarise how much I loathe that real-life war crime victims are being procedurally placed in a procedurally generated version of a city that is still irradiated to this day so that players can have "just like actual combat" experience in this real war.'

In that game, described in a CNN article as 'dehumanising Iraqi people' by Mohammed Husain, whose parents were Iraqi war refugees, you can also play as an Iraqi father trying to escape with his family, but that aspect too has been criticised as exploitative.

But if a game could potentially dehumanise and therefore lead to real-world discrimination, should real wars or contemporary geopolitics be depicted in games at all? It's a difficult question and one I can't answer with evidence because, while the impact of video games on empathy has been studied a little (as you'll know from hundreds of previous columns), video game psychology research is notoriously iffy.

Certainly, creators have always had the right to depict real life for entertainment purposes, whether that's in games or films or books, so maybe it just comes down to doing it well rather than badly. If historical warfare games can be guilty of desensitising and dehumanising, surely they could therefore educate and encourage empathy. In other words, an opportunity to be the goodies, not the baddies. **GPC**

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

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Incoming

RAZER MINI KEYBOARD GETS ANALOGUE SWITCHES

Razer has announced a new 60 per cent-sized gaming keyboard that uses the company's Analog Optical Switches. The Huntsman Mini Analog features adjustable sensitivity presets for the keys, as well as the ability to double-map them.

'This allows users to enjoy fine throttle-control or steering in racing games or assign two functions to a single key depending on how hard the key is pressed,' says the company, giving players the ability 'to have both walk and sprint on a single button in an FPS'.

The Huntsman Mini Analog also features doubleshot PBT keycaps, an aluminium chassis and a detachable USB Type-C cable. It's available to buy from **razer.com** now for £150 inc VAT.

NEW AMD CPUs INCOMING

AMD has announced that its first CPU to feature its new 3D V-Cache tech will be released worldwide on 20 April at a price of $449 US (around £410 inc VAT). The Ryzen 7 5800X3D has eight cores and 16 threads, via AMD's Simultaneous Multithreading (SMT) technology, and a whopping 96MB allocation of L3 cache thanks to AMD's 3D V-Cache tech, which can layer the cache vertically. Comparably, the Ryzen 7 5800X has 32MB of L3 cache.

The 5800X3D has lower clock speeds than the 5800X, though, with a 3.4GHz base clock and 4.5GHz boost clock, compared to the 5800X's 3.8GHz and 4.7GHz respectively, although both chips have the same 105W TDP. What's more, enthusiasts won't be able to multiplier-overclock the new CPU, so that's your limit for clock speed.

In addition, AMD has announced that it's finally filling out its product stack lower down, with some new Ryzen 7, Ryzen 5 and Ryzen 3 CPUs. All the new chips have a 65W TDP, but have a mix of the Zen 3 and Zen 2 architectures. The new Ryzen 3 4100 is a quad-core Zen 2 chip with a 4GHz boost clock and a $99 US price tag (around £90 inc VAT).

Other Zen 2 chips in the line-up include the 6-core Ryzen 5 4500 and Ryzen 5 4600G, with the latter coming with an integrated Radeon GPU. Meanwhile, the 6-core Ryzen 5 5500 uses the Zen 3 architecture, has a 4.2GHz boost clock and a $159 US (around £145 inc VAT) price tag, although it only supports PCI-E 3.

This is followed by the 6-core Ryzen 5 5600, which adds PCI-E 4 support, and the 8-core Ryzen 7 5700X, which has a 4.6GHz boost clock and a $299 US (around £228 inc VAT) price.

Rumour control

OUR ROUNDUP OF THE LATEST UNCONFIRMED TECH GOSSIP. TAKE THESE STORIES WITH THE APPROPRIATE PINCH OF SALT

RTX 3090 Ti RELEASE DATE LEAKED

According to the tech gossip fishers at **videocardz.net**, Nvidia is planning to officially release the top-end GeForce RTX 3090 Ti on 29 March. The site claims to have received embargo information about the new cards that was sent to board partners, suggesting that the card will be available at retail on the same date as reviews are allowed to be published. The RTX 3090 Ti features a fully enabled GA102 Ampere GPU, with 10,752 CUDA cores and 24GB of 21GHz (effective) GDDR6X memory.

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Nvidia gets hacked

Following a security breach at Nvidia, **Richard Swinburne** takes a look at the implications of some of the findings

On 23 February, South America-based ransomware/hacking group Lapsus$ claimed responsibility for stealing a terabyte of proprietary information from Nvidia. As I write this piece, the sensitive data is being gradually disseminated into the wild, and the group asserts it has information on Nvidia's upcoming hardware codenames, its DLSS technology, employee information, signed software certificates, GPU firmware and, supposedly, files that could divulge the core trade secrets of how its GPUs are designed.

Less than a week after the hack the group made its first public messages, and to prove the leak was real, it released the names and chip codes of Nvidia's next-gen GPUs. We already know that Nvidia will release GPUs based on its forthcoming (Ada) Lovelace architecture this year, but the leak gives us an idea of how the product line-up will look.

Lovelace line-up

The hacking group claims that Nvidia is preparing six GPUs, with models named AD102, AD103, AD104, AD106, AD107, and AD108. This represents the expected top-to-bottom family of consumer cards. As a side note, the 'AD' prefixes here would mean this is only the second time Nvidia has not used a G-letter codename (G70, G80, GK, GP, GA and so on) since its GeForce 7 series in 2005 – TU was the first.

The leak also tells us that the next-generation GPUs slated for 2024 will be codenamed 'Blackwell', after Dr David Harold Blackwell, American statistician, mathematician and game theory expert. No further details are yet known.

In what appears to be an attempt to justify its actions and win some public support, the group demanded Nvidia make its drivers open source by Friday, 4 March, 2022, otherwise it would release the Verilog files – the inner workings of how a chip is laid out at the transistor level, while also stating that 'we decided to help mining and gaming community'.

That's an A-grade contradiction for a lot of people, since miners and gamers generally compete for the same graphics cards, so the removal of the hash rate limiter would only benefit the former. If there were lingering doubts that these were flagrant extortionists, rather than benevolent hackers, within a day, the group then publicly offered a low hash rate (LHR) bypass tool for $1 million US.

It's unlikely anyone took the group up on the offer though. Miners have already found ways around LHR, via driver hacks, using laptop GPUs or simply mining non-Ethereum coins that aren't affected by the limiter.

On the plus side for gamers, with Ethereum prices tanking after November 2021, interest in buying GPUs for mining appears to be dropping off. Although the prices of graphics cards are still well above MSRP, the prices have dropped significantly over the past few weeks and that trend looks to continue, whether or not LHR is working.

The hacker group released the source code for Nvidia's DLSS tech

DLSS source code in the open

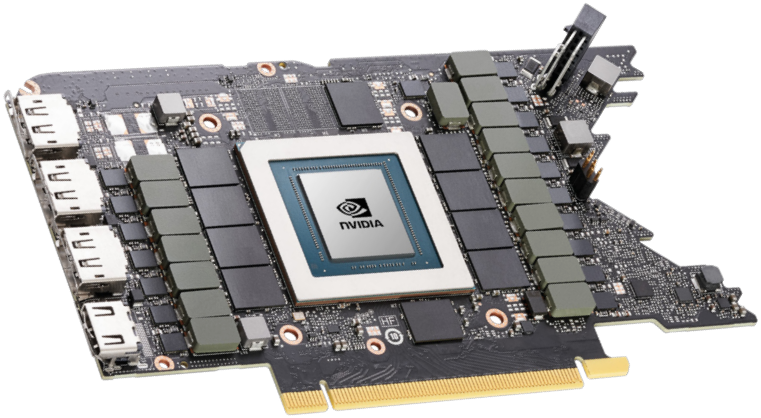
The group also released the source code for Nvidia's DLSS technology. Unlike AMD's FidelityFX Super Resolution (FSR) and Intel's XeSS tech, which are open source already, Nvidia keeps DLSS as a proprietary technology in order to retain a technical advantage. At the moment, DLSS is the only one of the above technologies with matrix processing hardware to support it in the form Nvidia's Tensor cores – and DLSS 2 is widely considered more effective then FSR.

Now the inner workings of DLSS are out in the open it could give competitors insights into how it achieves its results. We're not just talking about GPU makers here; smartphones and TVs are also increasingly making use of similar AI-based upscaling technologies.

The key word here is 'could', of course, as it's still stolen property even if it's out there. Anyone touching it would need to be legally insulated or beyond the reach of US law. Certainly AMD, Intel and other AI software designers have reminded their employees not to touch it with a barge pole.

Even though it's now in the wild, it's unlikely Nvidia will make DLSS open source, as DLSS 2 currently gives Nvidia GPUs a clear advantage. Only pressure from improving FSR and XeSS is likely to tip Nvidia's hand in that regard, just as Nvidia was pressured to support more displays with G-Sync following the wide adoption of FreeSync.

Ultimately that Friday deadline passed and the hardware folder didn't leak. Instead, over 70,000 employee



credentials were released, including email addresses and passwords. As of February, Nvidia employs just over 20,000 people globally, and it's unclear where the extra 50,000 comes from.

Two signed driver certificates were among the hacked data too. While these drivers expired in 2014 and 2016, Windows 10 and 11 still accepts them to sign kernel-level drivers. Security researchers noticed these leaked certificates were being abused by malware to sign infected files as early as 1 March, the very first day the group posted its demands. At the time of writing we're still waiting on Microsoft to issue a security update specifically addressing this driver vulnerability. CPC

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Letters

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CPU overclocking – one foot in the grave

I've just finished reading issue 224. Great stuff, as usual. Rarely do I drag myself from gaming long enough to communicate with other humans, and even more rarely do I agree with any of their opinions, but James asked us to reply on the subject of CPU overclocking, so this was one of those rare occasions.

I'm an old-school overclocker and have been doing it since around 1993, when I built my first PC to play Doom. It was a 25MHz 486DX overclocked to 33MHz with 8MB of RAM. Decades later, I was an early member of the 5G Club, though that doesn't mean much now. Every PC I've ever built had an overclocked CPU. Until now.

The graphical appearance of games has been one of the most important factors for me since day one. I had one of the first Riva TNT2 Ultra cards in the country, which I bought in Canada and brought home in my backpack. I was also a long-term user of SLI, at one point running three GTX 470 cards together to play Crysis at high settings.

I now game at 4K, and the top games such as Cyberpunk 2077 and Assassin's Creed Valhalla barely make it above 60fps with all the settings maxed out, even with a GeForce RTX 3080 Ti. For years, the GPU has been the main determining factor in how fast a game will run, and this is more true now than ever. I have a Core i7-11700K CPU and, in these games, it's running at 25-30 per cent capacity. I can overclock it to 5GHz on all cores, but doing so has no noticeable effect on game performance.

Of course, not all games are as graphically intensive as these ones, and some older or more basic games may be taxing my GPU so little that an increase in CPU speed could make them run faster. However, these games are already running at well above the refresh rate of my monitor, so again it would make no difference.

As a result, my CPU is drifting along at stock settings, generating so little heat that the fans on the radiator are barely turning – lovely and quiet. Now, not everyone is a gamer. Someone working with video content has very different needs. Multi-threaded video encoding does benefit from all-core CPU performance increases.

But modern CPUs are so powerful that they deal with this stuff pretty well. Reducing the time it takes to re-encode a video sounds great until you're talking about the difference between 60 and 65 seconds. It's going to take longer than that to make that next mug of coffee anyway. Also, your reviews and tests have shown repeatedly that manually overclocking modern CPUs often results in lower performance in the real world than allowing them to boost automatically.

Not everyone can afford (or even get hold of) the latest hardware – there are still people who are going to need to use older CPUs and squeeze the most out of them. For them, overclocking could still be a useful solution. For my part, I have to agree with James. For some others, maybe CPU overclocking has one foot in the grave, but I don't think it will be long before it lies down forever. Of course, the same isn't true of GPUs. Mine is water-cooled and running well above stock speed. CPU overclocking is dead. Long live GPU overclocking!

MILES HARRIS

Ben: Indeed, overclocking has changed a lot since the old days. I remember pushing my 333MHz Slot 1 Celeron up to 500MHz in the late 1990s (using a

When's the next issue out?

CUSTOM PC

MAY 05

Issue 226
On sale on Thursday, 5 May

If you own a modern CPU with loads of cores, such as the Core i9-12900K, you may as well leave it at stock speed

Review systems submitted to Custom PC usually have a specific, non-customisable spec in order to hit the price

100MHz front side bus), and it made an enormous difference. At this time, both AMD and Intel were also locking down multipliers across the board to stop people overclocking. Now AMD and Intel are fully endorsing overclocking on premium CPUs, marketing unlocked multipliers as a bonus and building automatic overclocking features into their chips.

I think it definitely depends on your CPU and budget. I have a Core i7-8700K rig in my home, for example, and it makes sense to overclock all its six cores to 4.8GHz – that's faster than the single-core boost clock and it results in a noticeably snappier system, without forcing the cooling fans to spin at silly speeds.

I also have a 12-core Ryzen 9 5900X system, though, and there's simply no point in manually overclocking it – as you say, it results in slower performance in anything that isn't hugely multi-threaded. And yes, it's well worth overclocking your GPU if you have the cooling headroom, but if you have a new top-end CPU with many cores, you're generally better off leaving it at stock speed, especially for gaming.

Review system prices

After reading the latest edition I decided to buy the PC Specialist Magnus Supreme system you reviewed – at that price it's a bargain. The trouble is that the price has gone up, but that's just the way it works I suppose. I usually build my own computers using your guides, but my last build was from 2015 with a Core i7-4790.

Anyway, with the advice from your review, I upgraded the M.2 drive for just £8. I also noticed the cooler covered two of the memory sockets, so I upgraded the memory to 32GB, and I chose a different case. The final system cost me around £350 more than the one in your article, but it should be a good basic gaming system for me. I'm getting on a bit now (73), but I still love playing some car racing games, Assassin's Creed and so on – this should keep me going for a bit.

CHRISTOPHER HALLOWS

Ben: Glad to hear you've got yourself a nice new system Christopher – that Alder Lake RTX 3070 Ti machine should indeed keep you going for a while. We've had a few people write to us about the price and availability of the PC Specialist Magnus Supreme, so I think it's worth clarifying how the prices of review systems work.

In general, when system builders submit machines for review, it has a specific spec, which will often be cheaper than speccing up the same machine in the 'configure a custom PC' section on their websites, as the system builder will have organised bulk purchases of specific components and so on, with the aim of matching a price point with a particular spec.

It may sometimes be worth giving them a call to see if they can swap out a small component such as an SSD, but most of the core spec will need to be left on its own, and changing it will generally significantly bump up the price. We've started listing direct links to the review systems in the 'supplier' sections at the top of PC reviews (using our own link shortener). These links will take you to the specific spec and price we reviewed, and the spec often won't be changeable.

However, in the case of the Magnus, we know PC Specialist has had some trouble getting stock of the CPU cooler, which has caused the link to come down a few times due to the way PC Specialist's website works. If any of our readers ever have trouble buying a review system at the spec and price in the mag (it should be good for the on sale date of that issue), please drop us a line and we'll try to resolve it. CPC

Reviews

MICRO-ATX B660 MOTHERBOARD

MSI PRO B660M-A DDR4 / £135 inc VAT

SUPPLIER ebuyer.com

While Intel's Core i5-12600K certainly benefits from an overclock to increase both single and all-core boost frequencies, the fact is that gains are still limited from multiplier overclocking compared with previous CPUs, while the further up the field you go, the less fruitful overclocking becomes. This means that CPU overclocking is getting much harder to justify, making a B660 motherboard such as the MSI Pro B660M-A DDR4 (which lacks overclocking abilities) a viable option for enthusiasts.

It's also far more affordable than Z690 motherboards, and one of the cheapest LGA1700 motherboards we've reviewed so far, retailing for just £135. However, MSI has clearly had to cut some corners to get here, so does it still do enough to appeal to your average budget-focused enthusiast who is looking to drop a Core i5-12400F or Core i5-12600K into it?

Both the board's banks of VRMs, which make up a 14-phase power delivery system, are cooled with heatsinks, which is a good start. Even if you won't be overclocking a Core i9-12900K, it means the board should cope fine with boosting any CPU in Intel's 12th-gen arsenal.

MSI even manages to include a USB Type-C header, M.2 heatsink and 2.5 Gigabit LAN port, but from here on the situation gets rather thin. There's no Wi-Fi, and you only get a rather meagre total of six USB ports on the rear I/O panel. We've seen worse, but the panel doesn't have a shroud or integrated I/O shield, which plenty of similarly priced boards in last issue's B660 motherboard group test did offer.

There are also only four PWM fan headers, which is the bare minimum to run a single or dual-fan cooler with a couple of case fans. You only get Realtek ALC897 audio, there's no USB Type-C port on the rear I/O panel and you get just a trio of audio jacks too, with no optical output. On closer inspection, the layout seems to be nearly identical to that of the MAG B660M Bazooka we reviewed in last month's Labs test too, including its support for DDR4, placement of all the on-board components as well as its micro-ATX form factor.

The pair of M.2 ports both lack MSI's tool-free SSD installation system we've seen on other boards, but they do support PCI-E 4, and the board's four SATA 6Gbps ports should be enough for most people looking to build a new PC or transplant their existing hardware, as long as you don't have half a dozen hard disks looking for a new home.

Similarly to the MAG B660M Bazooka, the VRM temperature peaked at 51°C under full load with our Core i5-12600K test CPU, while the tiny M.2 heatsink saw our PCI-E 4 SSD hit the same 64°C as its sister board, which was one of the warmer results on test last month.

If you're looking to drive monitors using your Intel CPU's integrated graphics, then the Pro B660M-A DDR4 does at least have two DisplayPort 1.4 ports and two HDMI 2.1 ports, all capable of dishing out up to 4K at 60Hz. You can also jazz up the board's bland appearance if you want, as there are

SPEC

Chipset
Intel B660

CPU socket
Intel LGA1700

Memory support
4 slots: max 128GB DDR5 (up to 4800MHz)

Expansion slots
One 16x PCI-E 4, one 16x PCI-E 3, one 1x PCI-E 3

Sound
8-channel Realtek ALC892

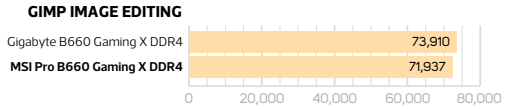
Networking
Realtek 2.5 Gigabit LAN

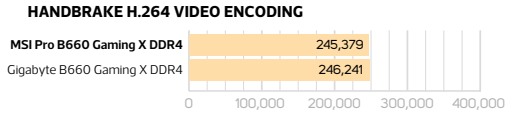
Cooling
Four 4-pin fan headers, VRM heatsinks

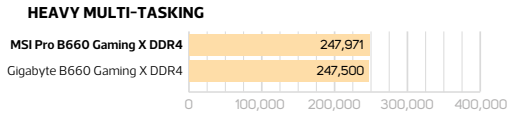
Ports
4 x SATA 6Gbps, 2 x M.2 PCI-E 4, 4 x USB 3.1 Type-A, 2 x USB 2, 1 x USB 3.1 Type-C header, 3 x audio jacks

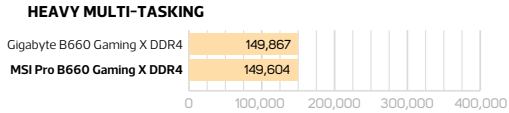
Dimensions (mm)
244 x 244

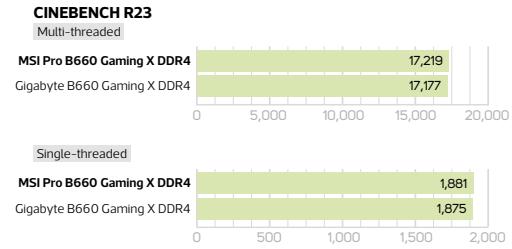
BENCHMARK RESULTS

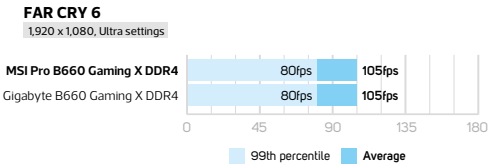


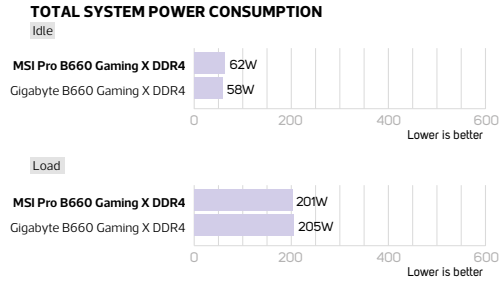












two 3-pin digital RGB headers on the board, although not surprisingly, no lighting on the board itself.

MSI's EFI is up to its usual standards, though, lacking few features compared with pricier boards, except overclocking abilities. It can even change temperature inputs for fan control to other options than the CPU.

Performance

Despite being one of the cheapest boards we've tested, the MSI Pro B660M-A DDR4 kept pace with the rest of the field, with a RealBench system score of 149,604 – only a slightly low image editing score prevents it from rising to the top of our B660 performance chart. The Cinebench results were on par too, with no sign the board had issues with boosting or VRM temperatures.

Meanwhile, the Realtek ALC897 audio is no match for one of the latest codecs, but it's one way that motherboard manufacturers cut costs. It's certainly fine for most people's PC audio needs, with a dynamic range of 93dBA and noise level of -95dBA, but these are still decidedly average compared with the best results we've seen from the ALC1220 codec, for example.

Power consumption sat at 201W under full load, which is a tad higher than the MSI MAG B660M Bazooka DDR4. However, with near-identical Far Cry 6 results, it's clear the two boards are essentially the same, just dressed in slightly different clothes.

Conclusion

If you prefer your motherboard to be plain and understated rather than having an edgy, gamer-focused design, the MSI Pro B660M-A DDR4 is definitely a classic example. It's not flashy, drenched in RGB lighting or in any way concerned about the way it looks. It also uses DDR4 memory, so it doesn't require expensive, questionably beneficial and often poorly stocked DDR5 memory either.

It's a little low on features, the audio codec is dated and it lacks the range of audio outputs on pricier boards, but so do lots of other B660 boards. At face value, it seems like a no-frills way to jump onto the Intel 12th-gen bandwagon. With many Alder Lake CPUs being compelling stock-speed performers, it's never been a better time to consider a B-series motherboard either, especially as you can also run your memory at higher frequencies than in the past too.

The trouble is that, despite having fewer features than nearly identical boards in MSI's range, it has a similar price. You may as well opt for a board that has a shroud to cover the I/O panel and an integrated I/O shield. Even the rather average MSI MAG B660M Bazooka DDR4 is better value and offers both of those features, while the ATX-sized Gigabyte B660 Gaming X DDR4 has considerably more features and only costs only a little more money.

ANTONY LEATHER

UNDERSTATED

- \+ Cheap price
- \+ Great EFI
- \+ PCI-E 4 support

BLAND

- – Comparatively poor value
- – Average features
- – Bland looks

PERFORMANCE **30/35**

FEATURES **26/35**

VALUE **21/30**

OVERALL SCORE **77%**

VERDICT

A cheap route to owning an Intel 12th-gen system, but it's lacking compared with similarly priced boards.

ATX CASE

FRACTAL DESIGN TORRENT RGB TG / £219 inc VAT

SUPPLIER scan.co.uk

If there's one company that has stepped up its game to stay ahead of the pack with case design, it's Fractal Design. The removable roof sections and other features on the likes of the Meshify 2 and Define 7 made the process of building a PC even more of a joy than usual, so we were pretty excited when we heard about a new ATX case landing from the company. However, the Torrent is interesting in a very different way to Fractal Design's recent efforts.

In fact, the case is a step backwards in some ways, as it loses the ability to ditch its roof section. With the Torrent, the company has gone back to a roof-mounted PSU, with a power supply area made of riveted panels. In a perfect world, we still feel a removable roof section would have been possible, perhaps with a removable PSU mount instead.

However, there are some clear differences to other cases that mount the PSU in the roof. The area is closed off from the main chamber, keeping PSU cables completely out of sight, thanks to a side channel that routes them behind the motherboard tray.

It also makes for a perfect area to stow the cables, while ensuring the PSU is far more accessible than it would be under a usual PSU cover. For instance, if you need to add or remove modular power supply cables, we'd far sooner do it with a system built in the Torrent than in a Define 7.

With no PSU cover, the lower chamber is a square open space, and to make the most of this design, Fractal Design has geared the Torrent towards high airflow. The flagship model on test here includes two enormous and powerful 180mm digital RGB fans in the front section, and three 140mm models in the base, with all the fans acting as intakes in order to create positive air pressure.

The 180mm fans dish out massive airflow, aided by an attractive front vent section with angular ridges, with airflow aimed at a huge area of hexagonal mesh at the rear of the case. At £219, the Torrent RGB TG is fairly pricey, mostly thanks to the digital RGB fans, but if you're happy to forgo RGB lighting (bar a small strip on the PSU cover), you can get the same case for £185.

With no roof fan mounts and only a 120/140mm mount at the rear, you're left with few options when it comes to using some form of liquid cooling and keeping the included case fans. There are 180mm AIO liquid coolers from the likes of Alphacool that could secure to the front fans, but mounting an AIO cooler to the bottom fans would mean the radiator and any reservoir section would sit well below the pump, which isn't ideal with these types of coolers.

Thankfully, Fractal Design has thought of this and included 120/140mm adaptors for the front section, allowing you to remove the 180mm fans and cater for smaller radiators instead. Custom water cooling fares much better, though, as there are single and even double 180mm radiators (180mm and 360mm) available, and of course, 280mm and 420mm radiators that can make use of the 140mm base fans. Plus, you can put a 360mm radiator in the base, as demonstrated in our feature (see p78).

Of course, the Torrent is ideal for air cooling, and its generous width offers 18mm of CPU cooler clearance and 423mm of graphics card clearance, even with the front fans mounted. There's no vertical graphics card support out of the box, although if you're desperate, most universal vertical mounts should fit, even with a radiator and single row of fans in the base.

There's E-ATX motherboard support too, but the case isn't overly huge at 54cm long and 53cm high. If that's still too large, there's even a Compact model in addition to the

SPEC

Dimensions (mm)
242 x 544 x 530 (W x D x H)

Material
Steel, plastic, glass

Available colours
Black, white

Weight
11.1kg

Front panel
Power, 1 x USB 3, 1 x USB 3.1 Type-C, stereo, mic

Drive bays
2 x 2.5/3.5in, 4 x 2.5in

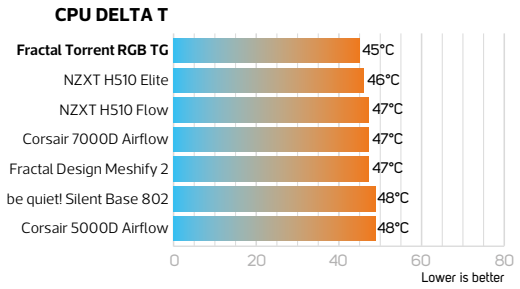
Form factor(s)
E-ATX, ATX, micro-ATX

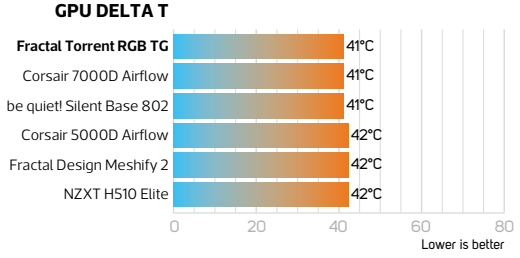
Cooling
3 x 120/140mm, 2 x 180mm front fan mounts (1 x 180mm fans included), 1 x 120/140mm rear fan mount (fan not included), 3 x 120/140mm, 2 x 180mm base fan mounts (3 x 140mm fans included)

CPU cooler clearance
188mm

Maximum graphics card length
423mm

TEMPERATURE RESULTS





mini-ITX-focused Torrent Nano (see p45), which is noticeably cheaper too. Both side panels are made from tempered glass and are tool-free, and normally we'd say the far panel requires some time spent tidying cables as even modest bundles of spaghetti will likely prevent its mounting pins from keeping it closed. However, Fractal Design has thought of this, and the Torrent enables you to secure the panels using screws from within the PSU chamber.

Also, rather than have the base fans sit directly on the case chassis, which would make installing radiators or other fans here very difficult, a fan mounting plate is included that caters for 120mm, 140mm and 180mm fans, so you could even swap the 140mm fans to the front of the case and place the 180mm fans here instead.

Meanwhile, the front panel offers the basic single USB 3 and USB 3.1 Type-C ports as well as audio jacks, but while you can power the fans from a SATA-powered fan hub, you'll need a separate 3-pin digital RGB lighting hub to control the lighting. Alternatively, you can use your motherboard's software and the RGB connectors for the fans, and case lighting can be daisy-chained too.

For such a large case, though, there's only two 3.5in hard disk mounts and four 2.5in SSD mounts, with these all sat behind the motherboard tray – cable tidying can be a tad cramped if most of these bays are occupied.

Performance

It was no surprise to see stellar out-of-the-box cooling from the Torrent, and the CPU delta T of 45°C was more than a match for any other case, bettering the Corsair 7000D Airflow and be quiet! Silent Base 802.

The Torrent's GPU delta T of 41°C was on par with the best results we've seen too, although it didn't better the likes of the Corsair 7000D Airflow. While the fans did produce a fair amount of noise at full speed, they lacked the unpleasant tone of smaller fans.

Conclusion

The Fractal Design Torrent is a refreshingly different take on an ATX case that looks great, offers stellar airflow and decent water-cooling potential. You'll need to consider your options if you want to use liquid cooling, as you might need to move fans around, but with an eye-catching front panel, RGB lighting and superb cooling, the Fractal Design Torrent is the ATX case to beat in 2022.

ANTONY LEATHER

VERDICT

Attractive, refreshingly different and super-cool – this is the case to beat this year.

FRACTAL

- \+ Excellent airflow
- \+ Large fans with low noise levels
- \+ Attractive design

FRACTURE

- – Rather pricey
- – No RGB lighting hub
- – Limited storage support

COOLING	29/30
FEATURES	15/20
DESIGN	28/30
VALUE	15/20
OVERALL SCORE	87%

ATX CASE

ANTEC NX700 / £70 inc VAT

SUPPLIER scan.co.uk

The last Antec case we reviewed, the DF700 Flux, was one of our favourite sub-£100 cases, thanks to its very reasonable price tag, good cooling and inventory of useful features. The NX700 we're reviewing here retails for a similar price and clearly looks the part, so we're hoping for more of the same from one of the oldest case manufacturers around. After all, Antec has certainly had plenty of experience in building good PC cases.

At a price of £70 inc VAT, the competition would include the Fractal Design Meshify 2 Compact and NZXT H510 Flow, although these cases retail for around £20 more. The NX700 clearly focuses on RGB lighting and aesthetics, with an aggressive front end that sports a mixture of mesh and diagonal vanes – an approach that puts it in good company this month, as Fractal Design's Torrent case (see p20) also leads on its front end.

That front mesh also acts as a dust filter, so there's no separate filter in this location, while the roof section benefits from a magnetic filter to prevent dust and detritus from falling into the case. Comparably, the PSU filter is a tad flimsy and just slots into place from underneath, but you won't be fiddling with this section regularly anyway.

Like the more expensive Torrent, the NX700 also has large 185mm RGB fans at the front, a big mesh front section and plenty of positive air pressure, with just a single 120mm RGB rear exhaust fan. The front section can also house a trio of 120mm or 140mm fans, and you can also mount a pair of each in the roof and another pair of 120mm fans in the PSU shroud to boost GPU cooling.

All three of the case's fans are hooked up out of the box and are also powered using a single cable. However, this cable is 3-pin rather than 4-pin PWM, so you'll need to ensure your motherboard's BIOS is able to fine-tune the fan speed according to temperature, switching it to voltage mode if necessary. That rear fan also acts as an RGB control hub for the front fans, controlled by a button on the front panel, allowing you to change lighting modes and colours without hooking up the case to your motherboard.

The lighting colour and mode options are basic, but there are also 3-pin digital and VDG connectors for Gigabyte motherboards that allow you to use your motherboard's own software to deal with the lighting instead. The RGB lighting is surprisingly vivid and accurate for such an affordable case, although the effect speed of the mode options is too slow for our liking, resulting in a slight stuttering effect.

The front panel's control button for the lighting sits next to two USB 3 ports and the audio outputs. Sadly, the front panel lacks a USB Type-C port, but that's rare on sub-£80 cases even in 2022.

For a mid-size case, the NX700 has good water-cooling potential too, with space up front for 280mm and 360mm radiators. Meanwhile, the roof can house up to 240mm or 280mm radiators, thanks to a large offset fan mount that can offer clearance for 45mm and 60mm-thick radiators, depending on the height of your motherboard's heatsinks.

Sadly, you won't be able to fit 180mm radiators in the front, as with the Fractal Design Torrent, as the fan

SPEC

Dimensions (mm)
220 x 440 x 492 (W x D x H)

Material
Steel, plastic, glass

Available colours
Black

Weight
6.7kg

Front panel
Power, 2 x USB 3, stereo, mic

Drive bays
2 x 2.5/3.5in, 4 x 2.5in

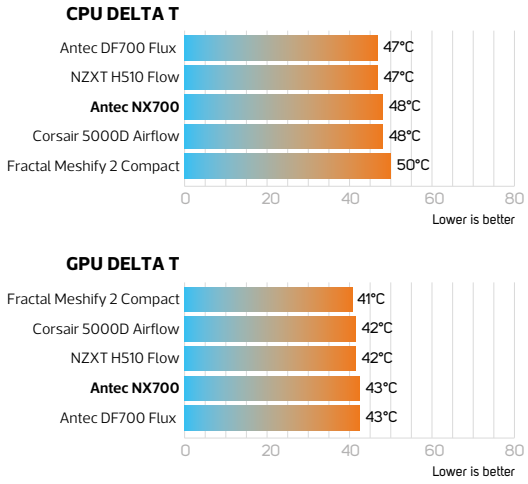
Form factor(s)
ATX, micro-ATX

Cooling
3 x 120/140mm, 2 x 185mm front fan mounts (2 x 185mm fans included), 1 x 120mm rear fan mount (fan included), 3 x 120/140mm roof fan mounts (fans not included)

CPU cooler clearance
170mm

Maximum graphics card length
340mm

TEMPERATURE RESULTS



WHAT A MESH

- \+ Good airflow
- \+ Snazzy RGB lighting
- \+ Great value

WHAT A MESS

- – Basic cable routing
- – Fan cable only has 3-pin support
- – No USB Type-C

mountings here aren't standard and there's not enough space. However, the NX700 makes a better home for AIO liquid coolers than the Torrent, with the roof being the logical choice for a 240mm or 280mm radiator. There's also plenty of CPU cooler clearance at 170mm, and you can install a graphics card up to 340mm long.

Storage bays are reasonable as well, with two 2.5in/3.5in bays in a removable enclosure under the PSU cover, plus four more 2.5in mounts on the motherboard tray. As with Antec's other recent budget-focused cases, though, our main criticism of the NX700 is a lack of refined cable-routing options.

Unlike the NZXT H510 Flow and Fractal Design Meshify 2 Compact, you only get the basics here, with just cable ties and open cable-routing holes. The case also lacks a vertical GPU mount, but does offer some smaller details, such as rails for the rear fan to shift up and down, so it can sit in line with your CPU cooler to boost cooling. You also get captive thumbscrews for both the steel and the glass side panels, and it's easier to deal with these than the usual quartet of screws that secure glass panels from the side.

Performance

In terms of noise, the Antec NX700 proved to be far quieter than the Fractal Design Torrent, simply because its fans spun much slower – it doesn't even make much noise with the fans running at full whack. The modest fan speed still resulted in respectable cooling results, though, with the NX700 bettering the Fractal Design Meshify 2 Compact by 2°C on the CPU delta T, matching the Corsair 5000D Airflow and coming just 1°C behind the NZXT H510 Flow and Antec DF700 Flux. It sat a couple of degrees above the Meshify 2 Compact with the GPU delta T, though, as it has less airflow directed at the GPU.

Conclusion

For a £70 case to include digital RGB lighting, three daisy-chained fans and decent cooling, the Antec NX700 represents a solid home even for a high-end PC. It looks great too, with the aesthetics bolstered by the high 185mm RGB fans and snazzy front mesh.

Of course, there will always be compromises at this price, and with basic cable-routing and tidying options, a lack of USB Type-C support and other limited features, the NX700's feature set stands in stark contrast to cases such as the Fractal Design Meshify 2 Compact, which costs just £20 more. However, we can appreciate at this price, that could bag you a half-decent air cooler if you're on a tight budget. If you're looking to keep costs to a minimum, but you still want to jump onto the RGB bandwagon, the Antec NX700 is a solid choice if not an unequivocal one.

COOLING 25/30

FEATURES 14/20

DESIGN 24/30

VALUE 18/20

OVERALL SCORE 81%

VERDICT

A solid, good-looking and affordable ATX case, although it's a little lacking in features.

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PCSpecialist

PCI-E 4 M.2 SSD

WD BLACK SN770 / £310 inc VAT (2TB)

£125 inc VAT (1TB - reviewed) £80 inc VAT (500GB) £67 inc VAT (250GB)

SUPPLIER ebuyer.com

It's easy to get confused over WD's naming schemes for its SSDs, but in general, if it's Black it's going to be fast, if it's Blue it's going to be not quite so fast and if it's Red it's going to have a decent endurance rating. The problem is that there are then different model names within those line-ups. The Black SN770 we're reviewing here isn't the only Black series SSD to sit in WD's arsenal, with the monstrous Black SN850 being one of our favourite PCI-E 4 SSDs.

As you'd expect, the Black SN770 also uses the PCI-E 4 interface, but at £125 inc VAT for a 1TB drive, it's only £12 cheaper than the flagship SSD. Storage prices fluctuate, of course, but we'd expect to see more of a difference at launch. Both SSDs come with a five year warranty, and both have similar capacity options ranging from 500GB to 2TB for the SN850, and with an extra 250GB option for the SN770. They even have identical endurance ratings, with our 1TB sample good for 600 terabytes written (TBW), which is the same as the SN850.

It's only when you get to the performance numbers that you see the difference between the two drives. The SN850 tops out at a claimed 7,000MB/sec read speed for all three capacities, while the SN770's maximum claimed read speed hovers around 5,000MB/sec unless you dip down to 250GB where it drops to 4,000MB/sec. Write speeds follow a similar pattern with 5,000MB/sec for the SN770 at 1TB and 2TB, down to 4,000MB/sec at 500GB and 2,000MB/sec at 250GB. The SN850, meanwhile, manages an extra 1,000MB/sec at 2TB and 1GB.

Under the hood is a WD in-house, 4-channel controller with triple-level cell (TLC) NAND flash memory, but no DRAM for caching, with the SSD instead relying on system RAM and speedy BiCS5 112-layer TLC memory to ensure the real-world speeds are what you'd expect from a modern PCI-E 4 SSD.

Like the Kingston Fury Renegade M.2 SSD (see opposite), there's also no heatsink on the SN770, which can potentially lead any PCI-E 4 SSD we've tested to edge a little too close to throttling. With no heatsink attached, the SSD peaked at the same 71°C temperature as the Kingston drive, but only after a back-to-back run of CrystalDiskMark as a stress test, during which it managed to still hit 5,226MB/sec read and 4,970MB/sec write speeds. Donning our motherboard's heatsink saw no improvement in speeds, though, unlike the Kingston drive.

Meanwhile, the SN770's 4K random 32-queue-depth four-thread read speed of 2,255MB/sec was on par with the SN850, which managed 2,172MB/sec – a difference that's within the margin of error for the test.

It was a similar situation for the 4K write speed of 1,932MB/sec, which was also more than a match for any other PCI-E 4 SSD we've tested, including the Kingston Fury Renegade. In AS-SSD, though, the Kingston SSD added 1,000MB/sec to the WD SN770's sequential read speed.

BLACK SABBATH

- \+ Excellent performance
- \+ Reasonable price
- \+ Doesn't throttle without heatsink

BLACK LACE

- – Not much cheaper than SN850
- – Cheaper SSDs offer similar real-world performance
- – Average endurance rating

SPEC

Full capacity
1TB

Formatted capacity
931GB

Interface
PCI-E 4

Heatsink
No

NAND
TLC

Controller
WD in-house

Endurance
600 TBW

Warranty
Five years

Conclusion

Current pricing for the WD Black SN770 offers decent value for a PCI-E 4 M.2 SSD, for a drive that offers great performance in both sequential and random tests. Even at £125 inc VAT for 1TB, though, you'd need some very good reasons to pick it over the WD Blue SN570, which costs £35 less money and isn't much slower in terms of real-world performance. Meanwhile, the WD Black SN850 is faster in sequential tests and costs only a little more money, making it a slightly better buy if you want the very best performance in all scenarios.

ANTONY LEATHER

VERDICT

Fast and reasonably priced, but there's stiff competition above and below it.

PERFORMANCE **46/50**

FEATURES **14/20**

VALUE **21/30**

OVERALL SCORE **81%**

PCI-E 4 M.2 SSD

KINGSTON FURY RENEGADE

/ **£285** inc VAT (2TB - reviewed) **£167** inc VAT (1TB) **£101** inc VAT (500GB)

SUPPLIER ebuyer.com

With many PCI-E 4 M.2 SSDs using the same flash memory and controller, it's often down to each manufacturer's firmware tweaks, pricing and durability to make their drives stand out. With a speedy Phison E18 controller under the hood, the Kingston Fury Renegade is certainly no slouch, and at less than £290 for 2TB and with a generous durability rating, it certainly seems to be competitively priced as well.

Our review sample is the 2TB model, which boasts a massive 2,000 terabytes written (TBW) endurance rating, but even the 1TB model offers 1,000 TBW, which is significantly more than the WD Black SN850, Samsung 980 Pro and other Phison-based SSDs such as the Corsair MP600 Pro. Only the slower WD Red SN700 offers more, and that's designed for NAS boxes, so credit to Kingston for stumping up such a good durability rating backed up with a five year warranty.

Meanwhile, the Kingston's Micron-made 3D triple-level cell (TLC) NAND flash memory can dish out a claimed read speed of 7,300MB/sec in sequential transfers, which is the same for all models, while Kingston claims the 2TB model can sequentially write at up to 7,000MB/sec, with this figure dropping to 6,000MB/sec and 3,900MB/sec for the 1TB and 500GB models respectively. Sadly, economies of scale don't work here, as the 4TB model is no faster than the 2TB model, but it costs three times as much, so you'd have to really want 4TB on a single drive to consider it.

In terms of the module itself, the Kingston Fury Renegade doesn't have a full heatsink, although it does have a sliver of graphene on top of the SSD to keep it cool while under load. However, the SSD still hit 71°C in the CrystalDiskMark benchmark in our back-to-back stress test, which occasionally saw speeds drop by several hundred megabytes a second.

Fitting our test motherboard's heatsink to the Kingston saw this peak temperature drop to 46°C with no further speed issues, but the extra cooling headroom failed to boost speeds any further.

In CrystalDiskMark, the Kingston's sequential read and write speeds of 7,025MB/sec and 6,792MB/sec respectively are only a fraction slower without the heatsink, but both figures are some way below the claimed top speeds. Meanwhile, the Kingston hit 2,165 MB/sec in our 4K random 32-queue-depth read test with four threads, which was bettered only a little by the WD Black SN850, with other Phison E18 SSDs coming south of 2,000MB/sec. However, other Phison E18 drives closely match the Fury Renegade's 1,794MB/sec write speed in this test.

AS SSD offered up read and write sequential speeds that were a little faster than the likes of the Corsair MP 600 Pro too, with the Kingston's 5,510MB/sec read speed being around 200MB/sec quicker, although the 4K random read and write speeds were a bit faster on the Corsair SSD.

Conclusion

Based on its endurance rating alone, the Kingston Fury Renegade is a better bet than many Phison-based PCI-E 4 SSDs, especially as it has a decent warranty. However, you'll need to ensure your motherboard has a heatsink for it (or buy one separately), as it can get toasty when running at full pelt.

This is why other SSDs may be a tad faster in some tests, as most similar models are equipped with much larger heatsinks. Thankfully, it's also well priced for an SSD that offers a 6,800MB/sec write speed, and it's the price that really makes this SSD so tempting, especially with its durability rating. If you want one of the fastest M.2 SSDs available for an affordable price, this is a great option.

ANTONY LEATHER

RENEGADE MASTER

- \+ Good value
- \+ Excellent endurance rating
- \+ Fast performance

ILL BEHAVIOUR

- – Can get toasty with no heatsink
- – Cheaper SSDs are nearly as fast
- – 4TB model is ridiculously expensive

SPEC

Full capacity
2TB

Formatted capacity
1,810GB

Interface
PCI-E 4

Heatsink
No

NAND
TLC

Controller
Phison E18

Endurance
2,000 TBW

Warranty
Five years

VERDICT

Fast, well priced and equipped with a decent endurance rating, but you'll want a heatsink for it.

PERFORMANCE **48/50**

FEATURES **15/20**

VALUE **23/30**

OVERALL SCORE **86%**

32IN GAMING MONITOR

CORSAIR XENEON 32QHD165 / 665 inc VAT

SUPPLIER scan.co.uk

NEON KNIGHTS

+ Fantastic build quality
+ Dazzling colour gamut
+ Snappy gaming performance

INCANDESCENT WITH RAGE

− Contrast too low for good HDR
− Expensive for the spec
− Warm sRGB colour balance

As one of the biggest PC gaming peripheral manufacturers around, Corsair entering the gaming monitor market got plenty of people excited, and its first (and as yet only) model is the Xeneon 32QHD165. It's a fairly high-end display with a price to match. What you get for £665 is a large 32in IPS display with a 2,560 x 1,440 resolution and a 165Hz maximum refresh rate.

Those figures aren't exactly groundbreaking, with the likes of the LG Ultra Gear 32GP850 offering the same screen size, resolution and refresh rate for nearly £200 less and the AOC U28G2XU providing a 4K resolution, 144Hz refresh rate and 28in screen for £100 less. However, the Corsair goes some way towards justifying the price with its build quality, colour reproduction and extras.

The 32QHD165 is built like a tank, with a hefty, solid extruded aluminium piece used for the leg of the fully adjustable stand, and an equally hefty arrangement of aluminium parts making up the sizeable base. Combined with the 32in screen size, you end up with a display that really dominates most desks. However, we found the stand a little less obtrusive and desk-hogging than the very long-legged, V-shaped bases used on some monitors.

A couple of cable-tidying clips slide up and down the aluminium leg, making for a simple but effective cabling system, while the ports all face down from the central bump on the back of the display. These consist of one DisplayPort 1.4 input, two HDMI 2 ports and a USB Type-C port for video input, along with a 2-port USB 3 hub, headphone output and barrel socket for the external power supply. There are no speakers, which is disappointing on a display this size and price.

A single mini joystick on the rear of the panel is used to control the pleasingly concise on-screen menus. You get all the key image quality and gaming performance controls you need, but none of the superfluous extras you find on some displays.

Turn on this display and you're immediately hit by its dazzling extended colour gamut. With its 98 per cent DCI-P3 colour space coverage, this monitor is essentially as colourful as you can get for a conventional computer display. What's more, the default colour temperature (6,962K), gamma (2.22) and average delta E colour accuracy (0.15) are decent, so although colours can look oversaturated, the balance is spot on.

If the oversaturated look isn't for you, an sRGB mode is on hand to rein in the colour gamut, although with a colour temperature of 7,097K, its balance could be better. As for HDR content, with a fixed backlight limiting contrast to a peak ratio of 1,045:1, you do get the dazzling colours required but not the range in brightness.

When it comes to gaming, though, the 32QHD165 impresses with a snappy response time combining with the fast refresh rate to make for a sharp-looking image during fast movements. There's also a decent backlight strobing blur reduction mode to further sharpen up the image in fast motion. It's a solid if unexceptional screen for gaming performance.

SPEC

Screen size
32in

Resolution
2,560 x 1,440

Panel technology
IPS

Maximum refresh rate
165Hz

Response time
1ms

Max brightness
400cd/m²

Backlight zones
1

Contrast
1,000:1

Adaptive sync
FreeSync and G-Sync

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

Audio
Headphone out

Stand adjustment
Height, pivot, rotation, tilt

Extras
100 x 100mm VESA mount, 4-port USB 3.2 hub

Conclusion

With its large screen and dazzling colour reproduction, the 32QHD165 makes quite an impact in games and video. It also has snappy gaming performance, a decent range of features and solid build quality. However, its HDR reproduction is let down by modest contrast and it's quite expensive for the raw resolution and refresh rate it delivers.

EDWARD CHESTER

IMAGE QUALITY 23/30

GAMING 24/30

FEATURES 16/20

VALUE 12/20

OVERALL SCORE 75%

VERDICT

A more than capable gaming display with great build quality, but you can get a similar spec for much less money elsewhere.

Wireframe

Join us as we lift the lid on video games

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MECHANICAL GAMING KEYBOARD

CORSAIR K70 RGB PRO / £170 inc VAT

SUPPLIER overclockers.co.uk

The Corsair K70 has been among the most popular mechanical keyboards since it first launched nearly ten years ago, and while it has gone through several design tweaks over the years, it's only now getting a full makeover. Out is the thick slab of coarsely brushed aluminium on its top, and in is a sleeker overall look. What's more, Corsair has added some premium extras, such as doubleshot PBT keycaps, an 8000Hz polling rate and a removable cable.

The new keyboard retains an aluminium top plate but it's nowhere near as thick or domineering as the previous version, with it no longer overhanging the plastic chassis below. We slightly miss the chunky quality of the older plate, but the new design certainly feels more pleasingly smooth.

This general sense of a slightly slicker, smarter feel runs throughout the new model. The clear plastic section that houses the backlit logo in the centre is now square and flush with the surrounding metal, plus it incorporates indicator lights for the various lock keys and mute buttons. The indicators disappear completely when they're not illuminated, making for a very clean look.

Also housed in the top edge are buttons for profile switching, adjusting the backlight brightness and locking the Windows key, along with a mute button and satisfyingly chunky, knurled metal volume wheel. These buttons have a very shallow but crisp action.

At the back of the keyboard, there's a single USB Type-C input for plugging in the main cable – there's no need to worry about a broken cable ruining your keyboard here. Alongside the USB socket is a sliding switch for setting the keyboard to Tournament mode, which disables macros and sets the backlighting to a static single colour.

Another improvement is the magnetically attached wrist rest, which easily pops off but remains secure in use. It's not padded but it's quite deep and offers a gentle slope on which your wrists can rest. Underneath the keyboard are four impressively large, thick rubber pads to provide a secure footing. Sadly, the flip-down feet to raise the back edge don't offer as much grip, so the keyboard slides around more when these are deployed.

We're fans of the crisp new key legend font, though, and the use of doubleshot keycaps made from hard-wearing PBT plastic rather than ABS is a major boon. Doubleshot means they use two layers of plastic to create the clear and black parts of the key, rather than using a black paint on clear plastic. This means the key legends can basically never wear away.

For key switches, Corsair uses the ever-reliable Cherry MX, so the typing and gaming experience is excellent. You only get three switch variants though – Red (linear), Brown (tactile) and Speed (linear with a shorter action). Meanwhile, the 8000Hz polling allows the keyboard to report its status to your PC eight times faster than typical 1000Hz keyboards and mice, although we found it made no difference to our experience whatsoever.

PROFESSIONAL GRADE

+ Smart overall design
+ Doubleshot PBT keycaps
+ Removable cable

AMATEUR HOUR

– Thinner aluminium plate than predecessor
– Expensive
– Slippy feet

SPEC

Dimensions (mm)
443 x 164 (238 with wrist rest) x 40 (W x D x H)

Weight
1.15kg

Format
Full-size – 105 keys

Connection
USB Type-C

Switch type
Cherry MX Mechanical

Switch life
50 million key presses

Backlighting
Individual key RGB

Polling rate
125-8000Hz

Keyboard rollover
N-key

Extras
Multimedia buttons, volume wheel, Windows lock/brightness/profile buttons, magnetic wrist rest

Conclusion

While it lacks some of the rugged charm of its predecessor, the new Corsair K70 makes up for it with plenty of new features and a generally sleeker style. The doubleshot PBT keycaps are a major improvement, as is the addition of a removable cable. The Tournament mode switch and 8000Hz polling are a little more niche, but otherwise this is a very solid – although certainly not cheap – upgrade to a venerable board.

EDWARD CHESTER

DESIGN 18/20
FEATURES 18/20
PERFORMANCE 26/30
VALUE 19/30

OVERALL SCORE 81%

VERDICT
It doesn't come cheap, but the K70 RGB Pro is a top-notch gaming keyboard.

USB MICROPHONE

RAZER SEIREN V2 PRO / £120 inc VAT

SUPPLIER amazon.co.uk

SIREN SONG

+ Decent sound quality
+ Stylish with lots of useful features
+ Naturally reins in loud shouts

DASHED AGAINST THE ROCKS

- Not the most sonic detail
- No XLR output
- Only one pickup pattern

The Seiren V2 Pro sits at around the same price and feature set as the Elgato Wave 2, EPOS B20, Blue Yeti and Shure MV7. However, it differs from these competitors in one crucial way. Where these are all condenser microphones, the Seiren V2 Pro is a dynamic microphone.

Traditionally, dynamic microphones are favoured for louder, more sonically varied environments where counteracting feedback is a priority. In other words, they're favoured for live concert settings, with the Shure SM58 being the quintessential vocal mic for gigs. Condenser microphones are generally more sensitive, but a little more susceptible to feedback and are more delicate. That's why they're favoured for studio use.

So, which is better for a streaming and home recording setup? A condenser mic is generally the more obvious option, but the Seiren V2 Pro holds its own sonically. There's plenty of detail, with a full, warm sound that works very well for in-game voice comms and podcast recording. It also copes well with sudden loud noises, making it great for preventing your expletive-ridden cries from distorting as you get sniped from across the map.

However, we also tried using the Seiren V2 Pro to record some acoustic guitar and found it sounded a little boxier, and lacking the same sense of being in the room with the player, as compared with the Shure MV7. You also miss out on the multiple pickup patterns – such as stereo – that some multi-condenser capsule mics such as the Blue Yeti include.

While it may not offer the absolute best bang for your buck for sheer clarity of recordings, the Seiren V2 Pro still has plenty going for it. For a start, it's an attractive and quite compact unit that's almost entirely built from solid metal, giving it a reassuring heft.

Its included stand is quite short, with an address position of just 18cm, so you'll need to angle it up towards you if it's mounted on a desk, but the base can be unscrewed from the pivot arm and the rest of the mic screwed onto a mic arm. Several other competitors don't include a pivoting arm of this quality.

Unlike many competitors, the Seiren V2 Pro also has a windsock. It isn't as effective as that of the Shure MV7, but it slightly reduces the whoosh and pops of breath and plosive syllables. Razer also claims the internals of the mic are on a shock-absorbing mount, but it isn't very effective, with every knock of the mic or desk heard loud and clear.

On the front of the mic are controls for gain and headphone monitoring levels, with a headphone jack on the back providing monitoring and audio output from your PC. A mute button sits above the volume dials and will glow green for 'go' and red for 'muted', making it clear when you're live. It connects via a USB Type-C socket around the back – there's no XLR output here – and Razer provides a long (3m), thick braided USB cable as well.

SPEC

Dimensions (mm)
78 x 56 x 196 (W x D x H)

Weight
552g with base, 367g without base

Sample rate
96kHz

Bit-rate
24-bit

Capsules
30mm dynamic

Pickup patterns
Cardioid

Frequency Response
20Hz–20kHz

Sensitivity
-34dB

Max SPL
120dB

Interface
USB (Type-C to Type-A cable)

Extras
Headphone amp with 3.5mm output, headphone volume control, gain control and mic mute control

Conclusion

The Razer Seiren V2 Pro is ideal if you're seeking a streaming-focused microphone. Its looks and feels great, its sound quality is decent and its natural ability to cope with loud outbursts will suit some gamers. Its included windsock, pivot arm and easy-to-use controls are all pluses too. It's not the last word in fine sonic detail, though, so isn't as well suited to recording or ASMR streaming.

EDWARD CHESTER

VERDICT

A great set of features and solid sound quality that's ideal for streaming, if not music recording.

DESIGN 17/20
FEATURES 14/20
PERFORMANCE 31/40
VALUE 16/20

OVERALL SCORE 78%

GAMING LAPTOP

HP OMEN 17 / £1,499 inc VAT

SUPPLIER hp.com

Most laptop companies concentrate on 15.6in and 16in screens these days, but HP's new Omen 17 shows that there's still plenty to like about larger devices. Its 17.3in screen is immediately immersive, and the 2,560 x 1,440 resolution gives you more pixels than conventional 1080p panels. Combine the resolution with the 165Hz refresh rate and 3ms response time, and you've got a screen that's well suited to gaming, despite the lack of adaptive sync.

Quality levels impress too. The brightness level of 375cd/m^2 and black point of 0.31cd/m^2 are ample, and the contrast ratio of 1,210:1 provides good depth and vibrancy. The delta E of 1.83 and colour temperature of 6,424K ensure accurate colours, and the panel rendered 94.1 per cent of the sRGB gamut, so it can produce virtually every tone required by games. The speakers are reasonable as well – the bass is weak, but they're loud and a strong mid-range means games sound punchy.

HP's large screen sits above high-end internals. The GeForce RTX 3070 GPU has 5,120 stream processors and 8GB of memory, and by default it has a generous 130W power limit that improves by 10W with the laptop's Performance mode engaged. Meanwhile, Intel's 8-core i7-11800H is a reliable CPU, and there's 16GB of DDR4 memory running at 3200MHz. You get decent storage too, with a 1TB Samsung PM9A1 SSD offering rapid read and write speeds of 7046MB/sec and 5140MB/sec, and there's dual-band 802.11ax Wi-Fi as well.

The Omen looks like a serious bit of kit, with a matt black finish used across the aluminium base and plastic lid. This sizeable machine has good external connection options too, with one Thunderbolt 4 connector that supports DisplayPort and charging, alongside three Type-A USB ports. It also has Gigabit Ethernet, mini-DisplayPort and HDMI 2.1, plus an SD card slot. Users can also remove the base panel to access pairs of SODIMM and M.2 sockets.

That's all good, but the HP's design isn't flawless. Its webcam doesn't have a privacy shutter and doesn't support Windows Hello, so this device has no biometric sign-in options. Build quality is mostly good thanks to the aluminium base, but the display flexes a little too much. Not surprisingly, this isn't a slim or light machine either – it weighs a hefty 2.78kg, it's 27mm thick and it's nearly 400mm wide.

Meanwhile, the keyboard has an impressive typing action thanks to fast, consistent buttons with plenty of travel – they're good for gaming and not far removed from low-profile, mechanical switches that you'll find on pricier portables. The keyboard has six macro keys, a button to open HP's Omen Gaming Hub and full-sized cursor keys. Disappointingly, the HP has no numberpad, its RGB LED lighting only extends to four zones, and the Power button sits on the keyboard itself, meaning you can accidentally switch off the machine if you slip. The hollow-feeling trackpad buttons aren't much good, either, but any serious gamer will use a USB mouse.

HP's Omen 17 squares up against our favourite affordable laptop – the Lenovo Legion 5 Pro. Both cost £1,499 and use the RTX 3070 with identical power levels, but Lenovo's machine has an AMD Ryzen 7 5800H CPU and a 16in display with a 16:10 aspect ratio, marginally better image quality and a higher resolution. It also has a numberpad, a webcam with a privacy shutter and more USB connections.

SPEC

CPU
2.3GHz Intel Core i7-11800H

Memory
16GB 3200MHz DDR4

Graphics
Nvidia GeForce RTX 3070 Laptop 8GB

Screen
17.3in 2,560 x 1,440 IPS 165Hz

Storage
1TB Samsung PM9A1 M.2 SSD

Networking
Gigabit Ethernet, dual-band 802.11ax Wi-Fi, Bluetooth 5

Weight
2.8kg

Ports
1 x Thunderbolt 4/USB-C/DisplayPort, 3 x USB 3.2 Gen 1, 1 x audio, 1 x mini-DisplayPort, 1 x HDMI 2.1, 1 x SD card reader

Dimensions (mm)
397 x 262 x 27 (W x D x H)

Operating system
Windows 10 Home 64-bit

Warranty
One year parts and labour return to base

CHONKY

+ Fast in games and applications
+ Large, high-quality screen
+ Good thermal performance
+ Satisfying typing and decent connection options

WONKY

– Thicker and heavier than rivals
– Some missing features
– Lid is a bit weak

PERFORMANCE

The GeForce RTX 3070 can just about handle smooth gaming at the Omen 17's native 2,560 x 1,440 resolution. It delivered 99th percentile minimums of 43fps in Assassin's Creed Valhalla and 37fps in Cyberpunk 2077, while averaging 140fps in Doom Eternal. That's enough pace to play single-player games at solid frame rates, especially if you drop the settings a little, and undemanding games can run at high frame rates on the 165Hz display too.

This GPU will run most ray-traced games with DLSS too. If you're willing to play at 1080p, the situation is even better – here, the HP averaged 195fps in Doom and beyond 60fps elsewhere. HP's machine outpaced the Lenovo in Assassin's Creed Valhalla and Cyberpunk 2077, and the two exhibited similar speeds in Metro Exodus and Doom Eternal.

The Omen's Intel processor did a tremendous job in application benchmarks too. It outpaced Lenovo's AMD chip in our Handbrake and multi-tasking tests and only fell behind in the image editing benchmark. Its overall result of 222,712 easily beat the Lenovo, and matched the best results we've ever seen from the 5800H. Switching over to the Omen's Performance mode improved that overall score to 234,777, with big gains in multi-threaded tasks but no noticeable boost to single-core speeds.

The HP's sizeable chassis helped it to perform well in thermal tests. When gaming in its 130W operating mode, the noise levels were modest, the exterior wasn't warm and the GPU's delta T of 50°C was good. In both multi-core and single-core workload benchmarks, noise and heat levels remained low, and we've no complaints about the CPU's 54°C delta T.

In terms of clock speed, the CPU's single-core benchmark speed of 4.5GHz was good, but its multi-core pace of 3.3GHz was mediocre. That issue was resolved in Performance mode, where the chip reached 4.2GHz without much extra fan noise. We wouldn't recommend Performance mode for games though – the speed boost is minor and the noise increases considerably.

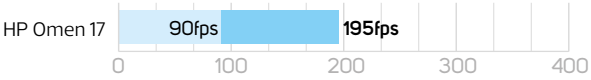
HP's machine also has an Undervolt mode that intelligently reduces CPU power consumption. This mode reduced the Omen's benchmark result to 205,046 with even less noise, so it's ideal if you want to reduce power consumption and noise levels. The Undervolt option feels a bit buggy though – it caused the Omen's working battery result to decline from five hours, 41 minutes to under three hours. Battery life is middling elsewhere – the HP's best result came with a video playback lifespan of over six hours, but it only lasted for 90 minutes of gameplay.

BENCHMARK RESULTS

58,349	581,885	218,796	222,712
GIMP IMAGE EDITING	HANDBRAKE H.264 VIDEO ENCODING	HEAVY MULTI-TASKING	SYSTEM SCORE

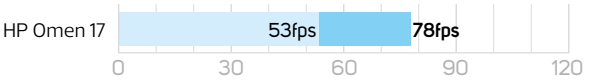
DOOM ETERNAL

1,920 x 1,080, Vulkan, Ultra Nightmare settings



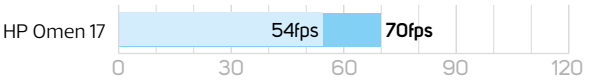
ASSASSIN'S CREED VALHALLA

1,920 x 1,080, Ultra High settings, High anti-aliasing



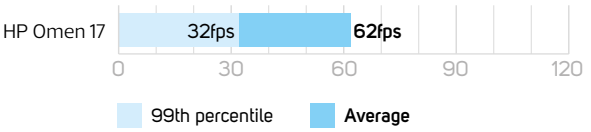
CYBERPUNK 2077

1,920 x 1,080, Ultra preset, no ray tracing



METRO EXODUS

1,920 x 1,080, Ultra settings, High RT, PhysX off, HairWorks off



CONCLUSION

HP's machine is a bit of a throwback, but that's not necessarily bad. Its large screen is immersive, its chunky chassis largely keeps down noise, and it has loads of power, a satisfying keyboard and good connection options. The slimmer, lighter Lenovo remains a more practical choice for most people, especially thanks to its high-quality 16:10 display. However, if you're happy to have a larger laptop for mostly deskbound gaming and work, the Omen is an excellent option that offers more performance for the same price.

MIKE JENNINGS

VERDICT

Large, fast and well featured for the money, the HP Omen 17 is excellent if you don't mind having a large machine.

PERFORMANCE	23/25
DESIGN	21/25
HARDWARE	21/25
VALUE	22/25
OVERALL SCORE	87%

INTEL Z690 GAMING PC

PC SPECIALIST MAGNUS PRO / £2,499 inc VAT

SUPPLIER pcspecialist.co.uk

It's unusual to find an RTX 3080 Ti PC for under £3,000 at the moment, but PC Specialist has done it here – and by some margin. Impressively, the Gigabyte-made graphics card inside the Magnus Pro is an overclocked model with a 1710MHz boost clock, and the card's 12GB of memory and 10,240 stream processors promise fearsome gaming pace.

It's a good start, and Nvidia's GPU sits alongside one of Intel's newest processors. The Core i7-12700K has eight Hyper-Threaded P-Cores that peak at 5GHz – barely slower than the same cores inside the i9-12900K – along with four power-efficient E-Cores.

The rest of the PC Specialist's specification is solid: the Magnus Pro has a 1TB Samsung 980 Pro SSD with rapid read and write speeds of 7,090MB/sec and 5,177MB/sec, and a Corsair RM850x PSU with modular design and 80 Plus Gold certification. The inclusion of 32GB of 3600MHz RAM is good for content creation too. It's DDR4 memory rather than DDR5, which isn't ideal for futureproofing, but our tests show very little advantage of using DDR5 over DDR4 with 12th-gen Intel systems.

As the Gigabyte Z690 UD motherboard is a DDR4 model, you don't get an upgrade path for faster memory either. The board has plenty of mod cons, though. Its primary 16x PCI-E slot supports PCI-E 5, it has three M.2 connectors that support 4x PCI-E 4 and it has 2.5Gbps Ethernet. There's an extra CPU power connector, and loads of on-board headers for cooling and lighting as well.

Meanwhile, the rear I/O panel sports a USB 3.2 Gen 2x2 Type-C port that handles 20Gbps transfers, alongside nine other USB ports of varying speeds. PC Specialist has also added a dual-band 802.11ax Wi-Fi card. The board's biggest issue is audio – its entry-level Realtek codec is partnered with three rear outputs and no optical S/PDIF. That's fine for everyday use, but it's a bit lowly in a machine at this price.

The board isn't littered with lights either, but that doesn't matter thanks to the Cooler Master MasterBox 450 chassis. The case's chunky fascia highlights a dramatic strip of RGB LED lighting that can be customised with software or a control box behind the machine's rear panel. The bold plastic strip combines with the lights on the graphics card, memory and powerful PC Specialist FrostFlow 360 AIO liquid cooler to create a dramatic interior.

The build impresses in practical departments too. The case is robust, the CPU cooler doesn't impede on the motherboard and there's plenty of room to work. The top of the case has a USB 3.2 Gen 2 Type-C port, and around the back, you'll find neat cabling and room for pairs of 2.5in and 3.5in drives.

While there are some compromises here, it's an astounding spec for the £2,499 price. The last PC we saw in this price range was AlphaSync's iCUE Gaming PC, which now costs £2,679, and that included an RTX 3080 alongside an AMD Ryzen 9 5900X. If you look back further, the last rig we saw with an RTX 3080 Ti came from Scan in Issue 221. And while the firm's 3XS Vengeance Ti included DDR5 memory and a Core i9-12900K processor, that PC now costs £3,679.

PC Specialist's standard warranty offers three years of labour coverage, one year of parts protection and one month of collect and return service. That's fine, but not the best deal around – you ideally want at least two years of parts cover on a machine at this price.

SPEC

CPU
3.6GHz Intel Core i7-12700K

Motherboard
Gigabyte Z690 UD DDR4

Memory
32GB Corsair Vengeance RGB Pro 3600MHz DDR4

Graphics
Gigabyte GeForce RTX 3080 Ti 12GB

Storage
1TB Samsung 980 Pro M.2 SSD

Networking
2.5Gbps Ethernet, dual-band 802.11ax Wi-Fi, Bluetooth 5

Case
Cooler Master MasterBox MB540

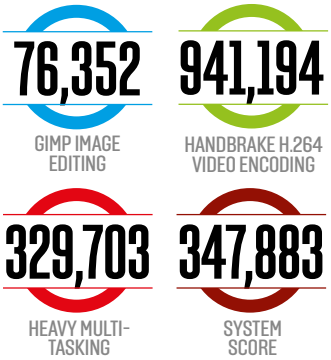
Cooling
CPU: PC Specialist FrostFlow 360 with 3 x 120mm fans; GPU: 3 x 90mm fans; rear: 1 x 120mm fan

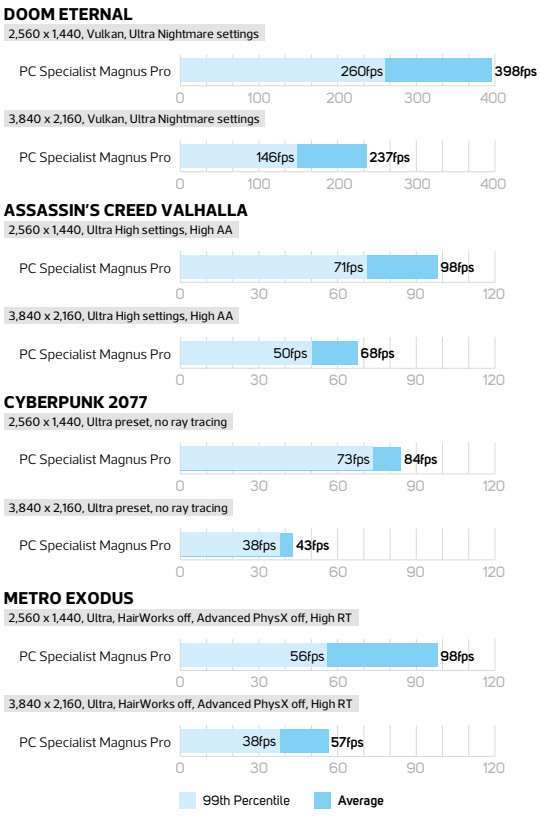
Ports
Front: 2 x USB 3.2 Gen 1, 2 x USB 3.2 Gen 2 Type-C, 1 x audio; rear: 1 x USB 3.2 Gen 2x2 Type-C, 1 x USB 3.2 Gen 2, 4 x USB 3.2 Gen 1, 4 x USB 2, 1 x PS/2, 3 x audio

Operating system
Windows 11 Home 64-bit

Warranty
One year parts and labour with first month collect and return, then two years labour only return to base

BENCHMARK RESULTS





PERFORMANCE

The overclocked RTX 3080 Ti delivers fantastic pace. At 4K, it returned playable frame rates in Assassin's Creed Valhalla, with a 99th percentile minimum of 50fps with a 68fps average. It dropped down to a 99th percentile of 38fps in Cyberpunk 2077, but that figure improves to 41fps if you enable Medium ray tracing and DLSS – you'll easily be able to get this rig playing demanding games such as this at 4K if you tweak your settings a bit.

Likewise, Metro Exodus isn't a cakewalk with ray tracing enabled, with the Magnus Pro dropping down to 38fps at 4K, but enabling DLSS saw this figure go up to 50fps. The machine also rattled through our Doom Eternal 4K test at 237fps, with a 99th percentile result of 146fps. This RTX 3080 Ti has a solid lead over the RTX 3080, and the PC Specialist also offers similar gaming speed to the Core i9-powered Scan machine. The only way you'll get more grunt is with an RTX 3090, and even then, the difference won't be significant.

It's no surprise that the PC Specialist keeps up with the Scan in games – the Core i7-12700K virtually matches the i7-12900K in lightly threaded workloads, even if it does fall behind in multi-threaded benchmarks. It's faster than the Ryzen 9 5900X in most tests too. Ultimately, the Core i7-12700K is a great all-round processor for tough workloads and content creation, as well as gaming.

Thanks to its 360mm AIO liquid cooler, PC Specialist's machine is a good thermal performer too. During gameplay and work benchmarks, the noise remained modest, and the CPU and GPU delta Ts of 51°C and 43°C are fine. Performance isn't an issue either – the processor's P-Cores ran at 4.7GHz during multi-threaded benchmarks and 5GHz in single-threaded tests.

CONCLUSION

The Magnus Pro is a mightily impressive machine for the money. Its overclocked graphics card delivers loads of gaming pace, the Alder Lake processor is fast, and the case is good-looking, quiet and accessible. You only get DDR4 memory and entry-level audio, but these small compromises are more than acceptable at this price. If you want a quiet, powerful and relatively affordable PC for top-end gaming and work, few are better than this example.

MIKE JENNINGS

VERDICT

A fast, quiet, and relatively affordable option for demanding gamers and content creators.

MAGNUM

+ Superb 4K gaming pace
+ Very fast Alder Lake CPU
+ Cool, quiet operation
+ Cheaper than most rivals

CHOC ICE

– Uses DDR4, not DDR5
– Entry-level audio
– Middling warranty

PERFORMANCE 23/25

DESIGN 23/25

HARDWARE 22/25

VALUE 23/25

OVERALL SCORE 91%

INTEL Z690 GAMING PC

GLADIATOR NOCTURNAL

/ £1,799 inc VAT

SUPPLIER custompc.co.uk/Nocturnal

Kitted out with loads of Noctua cooling gear, Gladiator's Nocturnal is devoted to keeping down fan noise – an admirable feat when so many rigs make a racket as soon as you load your favourite game. There are three 120mm NF-F12 PWM intake fans, alongside two exhausts in the roof and one at the rear, and the processor is chilled by a Noctua NH-U12S, which features another two PWM-enabled fans.

Even the graphics card gets the Noctua treatment. The GeForce RTX 3070 in this rig is the result of a collaboration between Asus and Noctua, which means the GPU has a vast heatsink with two Noctua NF-A12x25 PWM fans. It even has an overclock too, with the original boost clock of 1725MHz increased to 1815MHz.

An Intel Core i5-12600K sits beneath the Noctua CPU cooler, and it's a rock-solid mid-range chip with six Hyper-Threaded P-Cores that peak at 4.9GHz, alongside four E-Cores. The rest of the Nocturnal's specification is conventional, with 16GB of DDR4 memory at a middling 3200MHz and a 1TB Samsung PM9A1 NVMe SSD. Meanwhile, power comes from a be quiet! System Power 9, which has a temperature-controlled fan to reduce noise but only an 80 Plus Bronze efficiency rating and no modular design.

The Asus TUF Gaming Z690-Plus WiFi D4 is decent too. It offers 2.5Gbps Ethernet, dual-band 802.11ax Wi-Fi and Bluetooth 5.2, and its primary PCI-E slot supports PCI-E 5. It has a whopping total of four M.2 connectors, all of which use PCI-E 4, and it has an on-board Thunderbolt header and an extra CPU power plug. At the rear, you'll find a 20Gbps USB 3.2 Gen 2x2 Type-C port and six Type-A USB connectors. There's no fancy lighting or DDR5 compatibility, and the rest of the PCI-E slots only run at PCI-E 3, but it covers the essentials along with some of the latest tech.

It's all packed into a Corsair 4000D Airflow case, which looks eye-catching thanks to its white and grey colouring, and it's consistently robust. The top has a magnetic dust filter alongside sole USB 3.2 Gen 1 Type-A and Type-C ports, and channels on either side of the fascia direct air inside.

SPEC

CPU
2.7GHz Intel Core i5-12600K

Motherboard
Asus TUF Gaming Z690-Plus WiFi D4

Memory
16GB ADATA XPG GAMMIX 3200MHz DDR4

Graphics
Asus GeForce RTX 3070 8GB

Storage
1TB Samsung PM9A1 M.2 SSD

Networking
2.5Gbps Ethernet, dual-band 802.11ax Wi-Fi, Bluetooth 5.2

Case
Corsair 4000D Airflow

Cooling
CPU: Noctua NH-U12S with 2 x 120mm fans; GPU: 2 x 120mm fans; front: 2 x 120mm fans; roof: 2 x 120mm fans; rear: 1 x 120mm fan

Ports
Front: 1 x USB 3.2 Gen 1 Type-C, 1 x USB 3.2 Gen 1, 1 x audio; rear: 1 x USB 3.2 Gen 2x2 Type-C, 2 x USB 3.2 Gen 2, 1 x USB 3.2 Gen 1 Type-C, 4 x USB 3.2 Gen 1, 1 x optical S/PDIF, 5 x audio

Operating system
Windows 11 Home 64-bit

Warranty
Four years labour with one year parts and two months collect and return

Gladiator has done a great job with cabling – it's all kept neat, and wires don't block the pairs of 2.5in and 3.5in bays around the back. The pair of spare memory slots are free, but the sheer size of the graphics card means you'll have to remove it if you want to access the bottom half of the motherboard.

There's an awful lot to like about Gladiator's build – it's neat, tidy and well considered. The warranty isn't bad either, with four years of labour service, although you only get a year of the all-important parts cover – ideally, we'd like to see at least two years of parts cover with a machine at this price.

With so much dedicated cooling hardware on the inside, it's no wonder than the Gladiator is a bit pricey. It's at the top end of the price bracket for RTX 3070 systems, and for this money, you'll easily find rigs with the RTX 3070 Ti or Core i7 processors, albeit with noisier cooling systems.

PERFORMANCE

The concentration on noise reduction hasn't slowed down this PC's RTX 3070 GPU. The overclocked GPU zipped through single-player games such as Assassin's Creed Valhalla and Cyberpunk 2077 at 1,920 x 1,080 with 99th

DREAMY
+ Very quiet in all situations
+ Rock-solid gaming and processing power
+ Sturdy, tidy build
+ Good motherboard and SSD

NIGHTMARE
– Relatively expensive
– Mid-range memory
– Non-modular PSU

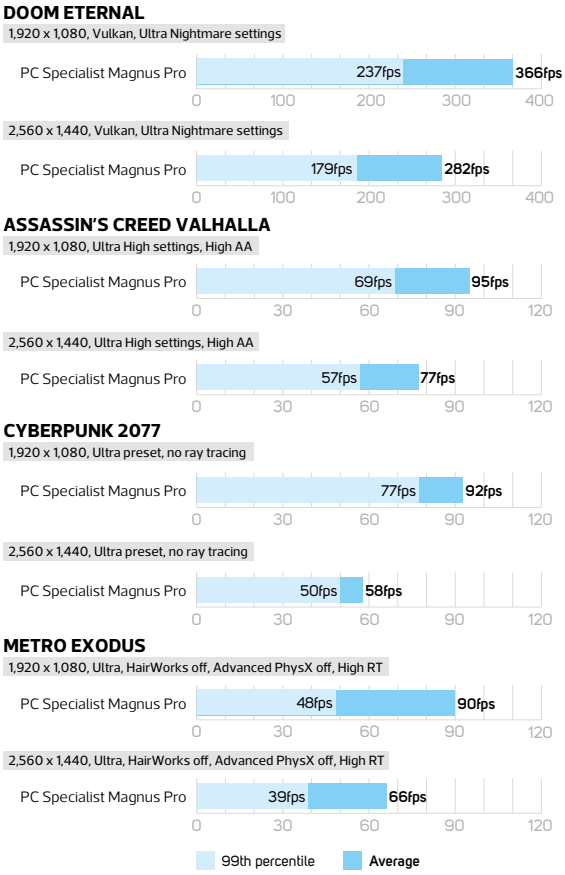
percentile minimums above 60fps, and the Nocturnal wasn't far behind in Metro Exodus. Upping the resolution to 2,560 x 1,440 saw those games maintain playable speeds, and the RTX 3070 handled ray tracing and DLSS at those resolutions. In Doom Eternal's 1080p benchmark, the RTX 3070 returned a monster average of 366fps.

The Nocturnal will happily play games at 1080p and 2560 x 1440, and it can play undemanding games at the speeds required by 240Hz panels. It's only going to struggle with 4K displays, and this system wasn't far behind RTX 3070 Ti rigs in most tests.

The Core i5-12600K is impressive too. Its overall benchmark score of 294,686 is miles ahead of AMD Ryzen 5 5600X PCs and on par with the Ryzen 7 5800X. This CPU is fast enough for mainstream creative tasks and multi-tasking, it's suitable for streaming and it won't bottleneck games. The SSD is good too, thanks to read and write results of 7,061MB/sec and 5,138MB/sec.

Crucially, the Nocturnal lives up to its promise of quiet operation. The modest, low-pitched fan noise is barely audible when the PC is idle, and it's only slightly louder during gameplay and tough work tests, which makes it one of the quietest RTX 3070 rigs we've tested.

BENCHMARK RESULTS



There's hardly any speed compromise either – the GPU ran at beyond 1900MHz during game benchmarks, and in a multi-core test, the processor's P-Core pace of 4.5GHz matched its theoretical all-core ability.

In a single-core test, the P-Cores peaked at 4.7GHz, which is only marginally behind this chip's stated pace. The CPU and GPU delta Ts of 41°C and 34°C are great, too, so we've got no temperature concerns.

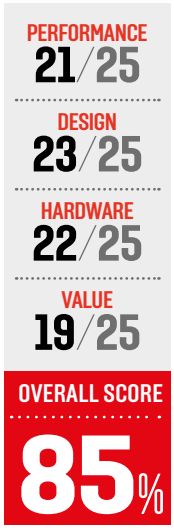
CONCLUSION

The Nocturnal is one of the quietest gaming PCs you'll find, and there's no noticeable performance sacrifice. It has a superb processor, an impressive enclosure and a good motherboard. Its memory and PSU could be improved, and it's relatively expensive for an RTX 3070 rig, but the cooling hardware is superb. If you want near-silent computing, it's worth paying a bit extra for a job well done.

MIKE JENNINGS

VERDICT

Solid performance and whisper-quiet operation, although it's understandably more expensive than rigs with equivalent core specs.



Custom kit

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

MSI FORCE GC20 V2 / **£26.69** inc VAT

SUPPLIER amazon.co.uk

The MSI Force GC20 V2 has an exceedingly complicated name for what amounts to an exceedingly simple control pad. It's a big, chunky, comfy unit, using the standard Xbox layout pattern. The comfort comes from its smooth lines and light weight, while its 2m wire and lack of batteries also help it to cut down on mass. The USB cable is a detachable micro-USB one, rather than a wire hooked straight into the pad, which is neater, replaceable and attaches with a satisfying clunk.

The construction feels solid all round, with responsive, clearly labelled buttons and a powerful motor for feedback. Both triggers have a consistent, responsive pull, making them ideal for driving games and other times when you need precision. Visually, the design is simple elegant monochrome, except the lights indicating whether the pad is connected to a PC (the default mode) or an Android device. The MSI Force GC20 is a clean, simple design that makes for a good pad. It's not Disco, but it does the job.

Du Bois ●●●●○ **Kitsuragi**

AOTHIA DESK PROTECTOR / **£13.99** inc VAT

SUPPLIER amazon.co.uk

The Aothia Desk Protector is what amounts to a very large mousepad, presented as a civilised piece of office furniture, rather than as the fragtastic killpal of a digital murderhobo with Monster energy drink for blood. Although the branding strategy may differ, the practicalities don't so much. The Aothia is an 80 x 40cm desk surface on which you can put your keyboard, mouse and other computer accoutrements.

The material choices are different, however. The Aothia is made of PU leather with a suede base to keep it still, and it works. It's comfy to rest your wrists on the surface and it works fine with a gaming mouse, plus it has enough give in it to be a good writing surface. There's definitely a period of waiting after putting it in place for it go properly flat, having been rolled up for shipping, but it gets the idea eventually. Although the choice of materials make for an unusual mousepad, it actually works well.

Insensible ●●●●○ **Sensible**

ROCKETEK USB HUB / **£19.99** inc VAT

SUPPLIER amazon.co.uk

The Rocketek USB Hub takes the problem of USB cable carnage and deals with it at a hub level. The device itself is a simple 4-port, unpowered USB hub, but what sets it apart is the casing, which offers either four self-tapping screws or a big Velcro pad to allow you to stick the hub to any given surface. This approach works well – you get a hub in a favourable position that stays put, making it easy to keep track of what's going where.

The lack of a power connection rather limits the utility – you'll be better off sticking to gamepads, headphones and other devices rather than external hard drives or other demanding kit. Also, the device is quite broad at 3.5cm, so there are some convenient PC-adjacent surfaces that will be too narrow to accommodate it, such as the side of a monitor. However, in spite of these minor flaws, the Rocketek does a simple job very well.

Hubbub ●●●●○ **Bub**

JLAB GO AIR POP EARBUDS / **£19.99** inc VAT

SUPPLIER amazon.co.uk

These tiny earbuds manage to pack a surprising amount of good into an almost comically small package. The Go Air Pop earbuds feel about as small as you could make an earbud without running the risk of losing it in your head. The sound quality delivered from these miniature devices is surprisingly good, and it's easy to get a snug fit in your ears, with a variety of tip sizes included.

They fall slightly short of what you might want for serious music fans, but for everything else, they hit the mark. The casing also has an unusual design – it doesn't support contact charging and it doesn't have any ports for charging wires – instead, it has its own USB cable attached that folds onto the bottom. It's a smart idea and very convenient.

The earbuds also switch on when removed from the case, and off when placed back in it. In addition, they can work solo if you don't mind missing out on one half or the other of the controls, which consist of a button on each bud, which you don't need most of the time.

The only particular flaw is battery life – you can run the pods off the battery in their charging case for over a day without charging it up, but the pods themselves struggle to last a couple of hours between charges. For short trips, though, the mini Go Air Pops do surprisingly well for the price.

Lost inside your head ●●●●○ **Lost in thought**

KEYSMART SAFEBLADE / **£9.99** inc VAT

SUPPLIER amazon.co.uk

Adding a useful blade to a keychain sounds like a clever idea until you run into the practicalities of having a sharp pointy thing bouncing around in your pocket. The KeySmart SafeBlade attempts to overcome this problem by being, as the name suggests, a safer sort of blade. In practice, this means you get a key-shaped box opener that you can slot onto your keyring, which enables you to open most packaging short of an armoured van, bank vault or plastic blister pack.

The size and shape of the SafeBlade is key –

literally, it's shaped like a key, and it's also smaller than a normal front door key. On a keyring with regular keys, the SafeBlade is less likely to protrude and jab you than usual pocket knives.

The SafeBlade is also made safer by not being very sharp, which is a notable shortcoming when it comes to opening things – you're basically using a very small thin piece of metal to poke or pry open objects.

Applying some force will get it through most materials, but not cleanly or without effort. On balance, using the SafeBlade is more civilised than ripping apart boxes with your hands like some sort of parcel-hating ape, but it doesn't go so far as to make it easy, which it probably should do.

Keyed car ●●○○○ **Car keys**

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

How we test

MOTHERBOARDS

TEST PROCESSORS

- **Intel LGA1700** Intel Core i5-12600K
- **Intel LGA1200** Intel Core i9-11900K
- **AMD AM4** AMD Ryzen 9 5900X

Common test hardware between our CPU test rigs includes a WD Red SN750 SSD, along with a WD Black SN850 SSD to test the speed of M.2 ports, and an Nvidia GeForce RTX 3070. We use 16GB (2 x 8GB) of Corsair Vengeance RGB Pro 3466MHz DDR4 RAM, or 32GB (2 x 16GB) of Kingston Fury 5200MHz DDR5 RAM.

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 6 on Windows 11. We also test each board's M.2 ports, and record the noise level and dynamic range of integrated audio using RightMark Audio Analyzer.

PROCESSORS

TEST MOTHERBOARDS

- **Intel LGA1700** Asus ROG Strix Z690-I Gaming WiFi
- **Intel LGA1200** MSI MEG Z490 Ace
- **AMD AM4** MSI MPG Gaming B550 Carbon WiFi
- **AMD AM4 APU** MSI MEG X570 Unify

Common gear includes a 2TB Samsung 970 Evo SSD and Nvidia GeForce RTX 3070 FE graphics card. For LGA1700 CPUs, we use 32GB (2 x 16GB) of Kingston Fury 5200MHz DDR5 RAM and a Thermaltake Toughliquid Ultra 360 CPU cooler. For other systems, we use 16GB (2 x 8GB) of Corsair Vengeance RGB Pro 3466MHz RAM and a Corsair Hydro-X water-cooling loop, with two XR5 240mm radiators, an XD3 RGB reservoir and an XC7 RGB waterblock.

We use the latest version of Windows 11 with security updates, plus the latest BIOS versions and drivers. We record results at stock and overclocked speeds, and tests include our RealBench suite, Cinebench, Far Cry 6 and Dirt 5.

For games, we record the 99th percentile and average frame rates either using the game's built-in benchmark or Nvidia FrameView. Finally, we note the idle and load power draw of the whole system, using Prime95's smallfft test with AVX disabled.

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 use CoreTemp to measure the CPU temperature, before subtracting the ambient air temperature from this figure to give us a delta T result, which enables us to test in a lab that isn't temperature controlled. We use Prime95's smallest FFT test with AVX instructions disabled to load the CPU and take the temperature reading after ten minutes.

For the Intel LGA1200 system, we take an average reading across all eight cores, and for the LGA1700 system, we take an average reading across both the P-Cores and E-Cores. AMD's CPUs only report a single temperature reading, rather than per-core readings, so we list what's reported in CoreTemp.

TEST KIT

Fractal Design Meshify C case, 16GB of Corsair Vengeance RGB Pro memory, 256GB Samsung 960 Evo SSD, Corsair CM550 PSU.

INTEL LGA1700

Intel Core i9-12900K at stock speed, Asus ROG Maximus Z690 Apex motherboard.

INTEL LGA1200

Intel Core i9-11900K at stock speed with Adaptive Boost enabled, MSI MEG Z590 Ace motherboard.

AMD AM4

Ryzen 7 5800X overclocked to 4.6GHz with 1.25V vcore, or Ryzen 5 5600X overclocked to 4.6GHz with 1.25V vcore on low-profile coolers, MSI MEG X570 Unify 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 at 1,920 x 1,080, 2,560 x 1,440 and 3,840 x 2,160, using an AOC U28G2XU monitor.

TEST KIT

AMD Ryzen 9 5900X, 16GB (2 x 8GB) of Corsair Vengeance RGB Pro SL 3600MHz DDR4 memory, Asus ROG Strix B550-E Gaming motherboard, Thermaltake Floe Riing 240 CPU cooler, Corsair HX750 PSU, Cooler Master MasterCase H500M case, AOC U28G2XU monitor, Windows 10 Professional 64-bit.

GAME TESTS

Cyberpunk 2077 Tested at the Ultra quality preset and Medium ray tracing preset if the GPU supports it. We run a custom benchmark involving a 60-minute repeatable drive around Night City, and record the 99th percentile and average frame rates from Nvidia FrameView.

Assassin's Creed Valhalla Tested at Ultra High settings with resolution scaling set to 100 per cent. We run the game's built-in benchmark, and record the 99th percentile and average frame rates with Nvidia FrameView.

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 Nvidia FrameView. This test requires a minimum of 8GB of graphics card memory to run, so it can't be run on 6GB cards.

Metro Exodus Tested at Ultra settings with no ray tracing and both Advanced PhysX and HairWorks disabled. We then test it again with High ray tracing if the GPU supports it. We run the game's built-in benchmark, and report the 99th percentile and average frame rates.

POWER CONSUMPTION

We run Metro Exodus at Ultra settings with High ray tracing at 2,560 x 1,440, and measure the power consumption of our whole graphics test rig at the mains, recording the peak power draw.

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

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

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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

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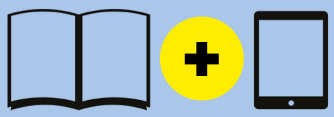

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LABS TEST

Mini but mighty

Antony Leather Puts seven of the latest mini-ITX cases head to head, so you can find the perfect home for a mini PC system

How we test

One of the key attractions of mini-ITX cases is the diverse range on offer. Some are geared towards offering the best support for liquid coolers and radiators, while others focus on air-cooled prowess. Some even come with liquid coolers pre-installed and some attempt to solve the issue of flexibility by being expandable.

For these reasons, comparing several mini-ITX cases can be tricky, as they're likely to be good in some areas and poor in others, depending which route the manufacturer has taken. To get around the varied competition this month, we're carrying out a couple of different tests.

Firstly, we test all cases where possible with the same CPU air cooler and with a minimum of two fans installed. If a case has no fans as standard, we add two Alphacool Eiswand 1,700rpm fans. No mini-ITX case should ever be run without fans, so it's pointless testing them in such a configuration.

The exception here is the NZXT H1 V2, which includes a 140mm all-in-one liquid cooler. However, we've also tested all the other cases with the largest liquid cooler they can support, up to 240mm in size, to highlight their peak liquid cooling potential.

We test all cases with an AMD Radeon RX 6700 XT graphics card, and while there are larger, more powerful cards available, with some cases offering wildly different graphics card clearances, we felt it best to aim for a card that would fit in the majority of mini-ITX cases while not being too easy a ride. It has its core and memory speeds locked to limit the impact of boosting, and we've also fixed the fan speed to 70 per cent in order to ensure our results are consistent.

We're using an Asus ROG Strix Z490-I Gaming motherboard, along with a Core i5-10600K CPU, which is the upper limit of what our small low-profile air cooler can manage in the stuffiest mini-ITX cases.

Temperature results are taken from CoreTemp (**alcpu.com/CoreTemp**) and GPU-Z (**techpowerup.com/gpuz**), and we subtract the ambient temperature from the results to give a delta T reading, which enables us to test in normal conditions across several days and varying temperatures. We score each case using weighted calculations for their cooling, design, features and value, which add up to create the overall score. Mini-ITX cases score additional points for noise levels (tested with a sound meter), use of space and overall size.

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FRACTAL DESIGN TORRENT NANO / £110 inc VAT

SUPPLIER scan.co.uk

There's no denying the Fractal Design Torrent Nano is large for a mini-ITX case. It dwarfs most of the other cases on test this month, but unlike a lot of larger mini-ITX cases, it doesn't allow its bulk to hamper aesthetics. With glass side panels and a unique vented front panel, the Torrent Nano is extremely attractive, while its added volume certainly has benefits in terms of accommodating your gear.

Its CPU cooler height limit stands at 165cm, which is more than double the limit of some other cases, making the Torrent the only case on test that can house a standard tower-shaped air cooler. It has an unusual layout, with the roof having no fan mounts and instead this space offers a home to an ATX PSU – the Torrent Nano is the only case in this Labs test to do so – and it has a very rare 3.5in hard disk mount as well.

NANO

- \+ Attractive design
- \+ Easy to work with
- \+ Full-sized cooler and PSU support

NO NO

- – Large
- – Inefficient use of space
- – Vented design increases noise leakage

SPEC

Dimensions (mm) 222 x 417 x 374 (W x D x H)

Material Steel, glass, plastic

Available colours White, black

Weight 5.5kg

Front panel Power, 1 x USB 3, 1 x USB 3.1 Type-C

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

Form factor(s) Mini-ITX

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

Maximum CPU cooler height 165mm

Maximum graphics card length 335mm

The cooling setup is unusual out of the box too, with a single 180mm RGB fan included that sits in the front of the case, blasting a good deal of air through it. In fact, adding a second fan in the rear of the case in our testing did nothing to improve thermals. If you'd rather use smaller fans, or an all-in-one liquid cooler, the case includes brackets to allow 120mm or 140mm fans to be installed here instead, with another pair of smaller mounts in the base of the case, from which fans can point at your graphics card.

The side panels are tool-free, there's plenty of space to work inside the case and it has the best cable routing of any chassis on test this month too, with a good deal of space behind the motherboard tray. If you fancy water-cooling your PC then there's space for 240mm radiators in the front or base of the case, with scope for using radiator-mounted pumps and reservoirs too – it certainly has the best water-cooling potential of all the cases in this Labs.

The huge front vent did mean that the case was the loudest on test, though, with a lot of noise escaping through it and the vented rear of the case, despite the large 180mm fan actually being quieter on its own than the 120mm fans we used in other cases. On the plus side, though, cooling was exceptional. Even out of the box with its single fan, it was a match for every other case – only the Lian Li Q58 with two extra fans managed to achieve a lower CPU delta T.

As the case only had one fan out of the box, and filling the rear mount didn't make much difference, we decided to add a second 120mm fan below the graphics card. The resulting GPU delta T of 42°C was the lowest on test as a result, and it was still competitive with just the single front fan, with a delta T of 46°C.

Conclusion

If you want to avoid using an SFX PSU, want room for a normal CPU air cooler and still want an attractive case, the Fractal Design Torrent Nano is the case for you. It's not small, but it's still compact enough to save plenty of desk or floor space, and it's a competent, affordable introduction to mini-ITX form.

VERDICT

It's not small, but the Torrent Nano offers excellent out-of-the-box cooling and makes for an easy build.

COOLING	FEATURES	OVERALL SCORE
29/30	17/20	83%
DESIGN	VALUE	
19/30	18/20	

GEEEK G1 SE / £124 inc VAT

SUPPLIER amazon.co.uk

Case manufacturer Geeek's cases have proven a hit in mini-ITX circles thanks to decent build quality, highly compact and efficient designs, plus reasonable price tags. The G1 SE is one of several similar cases from Geeek, which comes with slightly different configurations. Our test model sports top and bottom 120mm fan mounts, aluminium construction and magnetic acrylic side panels.

Its trump card is a supremely compact layout, with the case measuring just 33cm long and just over 14cm wide. The downside is that while this is perfect for a quartet of fans shifting air from bottom to top or vice versa with an SFX PSU and low-profile CPU cooler, it isn't great for any other setups. The CPU cooler height limit is just 66mm, which severely restricts your options, although similar cases such as the Lian Li Q58 and Phanteks Evolv Shift XT only offer a few millimetres more.

We don't think Geeek has considered fans of liquid coolers or custom liquid cooling either, as there's only space for a single 120mm radiator in the bottom and a pair of fans in the roof – it won't fit a radiator. Even a super-thin 20mm-thick radiator and slim 15mm fans won't fit, which is a shame, as just a few millimetres of extra clearance could have made it much more flexible.

Clearly, then, the case is designed with modest hardware in mind, especially given that the side panels lack any ventilation. Mesh panels are available separately, while a separate model includes them as standard, but we do have concerns for our graphics card in our solid-panel sample. On the plus side, this case was quieter than many other mini-ITX cases, as there are fewer areas for sound to escape.

The G1 SE uses a sandwich-style layout, but while other cases include a PCI-E 4 riser cable, here you only get a PCI-E 3-compatible cable – that's not ideal if you want to use one of AMD's Radeon RX 6600-series GPUs, as they only use an 8x PCI-E 4 interface – you'll also need to set your PCI-E slot to PCI-E 3 in the BIOS if you use a PCI-E 4 card.

The graphics card length limit sits at 325mm, but we'd have concerns over cooling high-end cards in this case anyway. There are no fans included as standard either, so that's an essential additional cost, and you might want buy a USB hub too as there are no front panel ports.

Building a PC into the G1 SE V1.0 was reasonably easy, but you need to deal with a few screws to get at the SFX PSU mount, which wasn't the case in the Ssupd Meshlicious or Phanteks Evolv Shift XT.

With two 120mm fans installed, the G1 SE managed a CPU delta T of 57°C, which was the third highest on test, but as expected, the GPU delta T was far poorer at a toasty 59°C – 8°C hotter than every other case on test. Liquid-cooling the CPU and keeping the two added 120mm fans proved to be the best option, though, shaving 9°C off the CPU delta T and 2°C off the GPU temperature, although these results were still the warmest on test.

Conclusion

We'd definitely opt for the vented side panel option with the Geeek G1 SE, as even with additional fans and liquid cooling, temperatures were still poor. It's a shame 240mm radiators are out of the question too. However, for a low-end PC, the Geeek makes for an attractive, extremely compact case that's well made and not hideously expensive.

SPEC

Dimensions (mm) 145 x 332 x 234 (W x D x H)

Material Aluminium, steel

Available colours Silver, black

Weight 2.8kg

Front panel Power

Drive bays 2 x 2.5in

Form factor(s) Mini-ITX

Cooling 2 x 120mm roof fan mounts (fans not included), 2 x 120mm base fan mounts (fans not included)

Maximum CPU cooler height 66mm

Maximum graphics card length 325mm

GEEK

+ Excellent use of space
+ Compact
+ Good build quality

DORK

– No fans included
– Poor cooling
– No space for 240mm radiators

VERDICT

Beautifully crafted and highly compact, but the G1 SE has limited cooling.

COOLING	FEATURES	OVERALL SCORE
18/30	9/20	71%
DESIGN	VALUE	
29/30	15/20	

KOLINK ROCKET COMPLEX / £149 inc VAT

SUPPLIER overclockers.co.uk

At £150 inc VAT, the Kolink Rocket Complex is quite pricey, but part of the reason for this cost is the case's extensive use of aluminium. The exterior benefits from three vented sides, with a U-shape section covering the roof and two sides (secured with numerous screws), and a fourth tempered glass panel held in place with thumbscrews. This makes it very similar to NZXT's H1 V2, but the latter's tool-free side panels are much more user-friendly.

The vents on the Rocket Complex are fairly large, but they're widely spaced and the resulting airflow isn't as large as you might expect. There's also no dust protection and the holes aren't small enough to prevent dust ingress on their own, unlike the vents on the NZXT H1.

There's a single USB Type-C port, a USB 3 Type-A port and a power button on the front panel, which is the same configuration as the H1 V2, but the Rocket Complex benefits from a vent in the roof, as well as dual 120mm fans included as standard, plus space for a 240mm AIO liquid cooler. However, The Kolink is a little taller and wider than the NZXT case as a result.

It does have other advantages, though, such as the second biggest CPU cooler clearance on test at 110mm, as well as room for a 2.8-slot graphics card with a length of up to 330mm, plus a PCI-E 4 riser cable. Without an included AIO liquid cooler and PSU included, it's also substantially cheaper than the NZXT, of course.

However, build quality is a tad mixed, with some rough edges.

In terms of storage options inside, there are four 2.5in mounts, but no space for 3.5in hard disks despite its size. Working with the case is fiddly, as several parts need to be unscrewed in order to install the PSU or radiators.

The PSU mount is in the roof, but you can't just drop it into the mount thanks to an annoying lip in the surrounding panel – you'll need an SFX or SFX-L PSU too. Disappointingly, there are also no case feet included, so you'll want to make sure your desk surface is protected if it's easily scratched.

Despite our concerns about the lack of ventilation, the Rocket Complex actually performed very well, with its CPU delta T of 54°C being second only to the Lian Li Q58 and Phanteks Evolv Shift XT in Air Boost mode. Both the latter results were obtained using our test fans, while the Rocket Complex achieved this result using its own 120mm fans.

The GPU delta T of 44°C was equally potent; using a 240mm AIO liquid cooler on the CPU saw the Kolink outstrip the NZXT H1 V2's CPU and GPU temperatures by several degrees. The Kolink also produced similar noise levels to other cases, despite the trio of large vented panels potentially enabling noise to escape.

Conclusion

Despite having a few advantages in some areas, the Kolink Rocket Complex doesn't quite wow us in the same way as the NZXT H1 V2. It falls short in terms of build quality, ease of use and refinement and it just feels a little rushed and rough around the edges compared with the other cases on test this month.

The Rocket Complex's cooling is great, and it looks good too, but there are better options available for less money.

SPEC

Dimensions (mm) 215 x 213 x 449 (W x D x H)

Material Aluminium, steel, glass

Available colours Titanium grey

Weight 4.45kg

Front panel Power, 1 x USB 3, 1 x USB 3.1 Type-C

Drive bays 4 x 2.5in

Form factor(s) Mini-ITX

Cooling 2 x 120mm side fan mounts (fans included)

Maximum CPU cooler height 110mm

Maximum graphics card length 330mm

STRAIGHT FORWARD

+ Good CPU and GPU cooling
+ Attractive design
+ 240mm AIO liquid cooler support

COMPLEX

- Average build quality
- Overly complicated installation
- No protective case feet

VERDICT

Decent cooling out of the box, but the Rocket Complex is a little unrefined and rough around the edges.

COOLING	FEATURES	OVERALL SCORE
27/30	10/20	62%
DESIGN	VALUE	
13/30	12/20	

LIAN LI Q58 / £150 inc VAT

SUPPLIER overclockers.co.uk

The fabulous Lian Li Q58, which we've already reviewed in **Custom PC** recently, is now available with a PCI-E 4 riser cable out of the box, although this addition sees the price rise from £125 to £150. Its mix of vented and clear split side panels makes it stand out and is also rather clever. You get at least some view of your shiny hardware, while air-cooled graphics cards and CPU coolers will also benefit from the lower mesh panel.

If you want to go all-out with mesh, though, Lian Li offers replacement panels for the Q58, replacing the glass panels included as standard on both sides.

We also love the Q58's pop-on panels, which make it so much easier to open and close than the likes of the Kolink Rocket Complex, although it's still not as sublime as the Ssupd Meshlicious. Installing a PSU is a tad fiddly, and the power lead extension cable that routes from the rear of the case to the PSU is tough to insert in your PSU too. However, we love the fact that the side panels slide off as well as hinging open. Meanwhile, installing the rest of the hardware, as well as liquid coolers, is simple thanks to a removable radiator mount. You even get a PWM fan hub too.

No fans are included as standard, so you'll need to buy your own, but we added two 120mm fans as an intake, and exhaust setup in the base and roof for testing. There's clearance in the roof to house a 240mm radiator and a single row of fans, and it's a reasonably compact case too, measuring just 34cm long and 25cm high. Unlike the Geeek G1 SE, the Q58 also comes with a USB Type-C port, a USB 3 port and an audio port on its front panel.

The innards can be moved around, or you can add to them, allowing for 3.5in hard disks and ATX PSUs to be installed, at the expense of a roof fan mount, while a handy hot-swappable 2.5in bay means you can easily remove your SSD. Apart from a slightly cramped interior, there were very few places to stow cables, but this is often the case with sandwich-style cases.

With two of our own fans installed, the Q58's CPU delta T of 53°C was excellent, topping the chart along with the Phanteks Evolv Shift XT in its Air Boost mode. It also bettered the Ssupd Meshlicious by 5°C thanks to the latter having a glass panel on the CPU cooler side. Clearly, the Q58's half-vented panels work. The GPU delta T of 45°C was also very good, although the Fractal Design Torrent Nano with an extra fan installed, and the Kolink Rocket Complex in its stock configuration, were even better.

With a 240mm AIO liquid cooler fitted, the Ssupd Meshlicious' extra ventilation recorded a CPU delta T that was 7°C lower than that of the Q58, and its GPU delta T was cooler in this configuration too. However, it was also 3dBA louder than the Q58 due to added noise leakage.

PCI-E 4

+ Compact design
+ Decent air-cooled results
+ Useful features

VESA LOCAL BUS

− No fans included
− Mediocre ventilation for liquid coolers
− Extra mounts sacrifice fan and radiator compatibility

SPEC

Dimensions (mm) 170 x 340 x 250 (W x D x H)

Material Aluminium, steel, glass

Available colours White, black

Weight 4.5kg

Front panel Power, 1 x USB 3, 1 x USB 3.1 Type-C, 1 x audio

Drive bays 4 x 2.5in, 1 x 3.5in

Form factor(s) Mini-ITX

Cooling 2 x 120/140mm roof fan mounts (fans not included), 1 x 120mm base fan mount (fan not included)

Maximum CPU cooler height 67mm

Maximum graphics card length 320mm

Conclusion

The Lain Li Q58 still comes recommended, but it's better suited to air-cooled systems, as other cases worked better with our AIO liquid cooler. We love its compact, flexible design, though, and you certainly won't be disappointed if you buy it.

VERDICT

The Lian Li Q58 is a well thought-out home for a mini PC, although it's better suited for an air-cooling setup than for liquid cooling.

COOLING	FEATURES	OVERALL SCORE
25/30	14/20	81%
DESIGN	VALUE	
26/30	16/20	

NZXT H1 V2 / £339 inc VAT

SUPPLIER ebuyer.com

The NZXT H1 V2's high price might put off many potential customers, but inside this well thought-out, attractive and very well-built mini-ITX tower case you'll find a 750W 80 Plus Gold PSU, 140mm AIO liquid cooler and a software-controlled fan hub. These inclusions would cost a significant amount of cash if you bought them separately, helping the NZXT H1 V2 to justify its price.

Not only that, but the cables for all these components are all neatly tidied and routed for you out of the box, ready and waiting for your hardware. As a result, the NZXT H1 V2 is one of the easiest mini-ITX cases to get to grips with, making an ideal introduction to the world of mini PCs.

It's tall for sure, with a height of over 40cm, but its width and depth of under 20cm means it takes up less desk space than many small mouse mats. The H1 V2 boasts an extra fan and larger ventilation holes over the original version of the case, as well as a redesigned PCI-E riser cable that's now PCI-E 4-compatible. It also has an extra USB 3 port on the front panel, in addition to a Type-C port and audio jack.

It's far more refined compared with the Kolink Rocket Complex, with slide-on and pop-on panels instead of requiring you to deal with dozens of screws. Meanwhile, the hinged radiator mount means the included AIO liquid cooler flips outwards, providing easy access to the motherboard tray.

Only 2.7-slot graphics cards are supported, but the length limit of 324mm will be ample for all but the largest cards. There isn't much storage space, though, with just a pair of 2.5in SSD mounts, so you'll need to invest in M.2 SSDs if you need more storage.

As with the original case, three of the side panels are vented, with the fourth panel made from tempered glass, but there's an improved area at the rear of where your graphics card sits. This is more open than in the original design, and it has a 92mm exhaust fan to offer a more comfortable home for RTX 3000-series cards with flow-through fans.

As the H1 V2 includes a liquid cooler, we haven't tested it with our standard air-cooled kit, but instead compared it with other cases with AIO liquid coolers installed too. The CPU delta T of 42°C with our Core i5-10600K was higher than the temperature from the Fractal Design Torrent Nano, Ssupd Meshlicious and Kolink Rocket Complex, all of which could house a larger 240mm liquid cooler.

However, the H1 V2 beat the Lian Li Q58 with its larger liquid cooler, thanks to the latter having poor ventilation for it. Meanwhile, the NZXT's GPU delta T of 49°C was bettered by the similar Kolink Rocket, Ssupd Meshlicious and Fractal Design Torrent Nano, but they all generated higher noise levels to get there.

SPEC

Dimensions (mm) 196 x 196 x 405 (W x D x H)

Material Steel, glass

Available colours White, black

Weight 7.6kg

Front panel Power, 2 x USB 3, 1 x USB 3.1 Type-C, 1 x audio

Drive bays 2 x 2.5in

Form factor(s) Mini-ITX

Cooling 1 x 140mm AIO liquid cooler (140mm fan included), 1 x 92mm side fan mount (fan included)

Maximum graphics card length 324mm

ALL INCLUSIVE

+ Eye-catching design
+ Pre-installed cooler and PSU
+ Easy installation

HIDDEN COSTS

– Limited storage options
– Expensive
– Limited cooling headroom

Conclusion

The NZXT H1 V2 can handle the latest mainstream desktop CPUs and high-end graphics cards in a unique, attractive and well thought-out case. The included PSU, liquid cooler and software-controlled fan hub would retail for close to £200 on their own, so the case and its PCI-E 4 riser cable cost around £140, which is reasonable. We have no problem recommending it if you want an easy-to-use case with a super-small footprint.

VERDICT

Attractive and easy to work with, as long as you're happy to use the included liquid cooler and PSU.

COOLING	FEATURES	OVERALL SCORE
25/30	19/20	85%
DESIGN	VALUE	
29/30	12/20	

PHANTEKS EVOLV SHIFT XT / £135 inc VAT

SUPPLIER overclockers.co.uk

The new RGB lighting-equipped Phanteks Evolv Shift XT currently has a very tempting discounted price of £135 inc VAT on **overclockers.co.uk** at the moment, but how does it stack up against our favourite mini-ITX cases as well as some of the new kids on the block? For starters, it's still one of the best-looking cases available – it even nearly persuaded our editor to build a small form factor PC too.

It also has a unique feature in its vertically expanding roof section, so we were interested to see how its cooling performance compared with the competition. In Compact mode with the roof sections sat all the way down, there's no space for internal case fans, while two can be fitted in Air Boost mode (with the roof raised a little) and there's space for a radiator too in Expanded mode (with the roof raised all the way up). It even gives the tiny Geeek G1 SE a run for its money in Compact mode, but still has a chunky look and a hefty feel thanks to its large aluminium panels.

However, while these panels add girth and make it seem larger than cases such as the Lian Li Q58 in photos, it's actually barely any bigger than the Q58 in the flesh. The panels are also removable, revealing an inner shell and flip-open fan and radiator mount, providing excellent access to the otherwise cramped interior. This means it's one of the easiest cases for PC building. No fans are included, so we added two of our own test models, as well as a 240mm AIO liquid cooler for our thermal testing.

RAISE THE ROOF

+ Brilliant aesthetics
+ Good cooling in expanded modes
+ Easy installation

RAISE THE ALARM

– No fans included
– Poor cooling in Compact mode
– Only one 2.5in mount

The front panel is situated at the base of the front end and offers a standard USB 3 port as well as a Type-C port, but there's just one 2.5in SSD mount inside, making it very limited in terms of storage. If you go for an air-cooled CPU, then the CPU cooler height limit of 72mm is also going to prove restrictive, but it's actually on the generous side for this style of cases. On the plus side, the graphics card length limit of 324mm won't hinder many choices and there's support for triple-slot graphics cards, plus a PCI-E 4 riser cable to deal with the sandwich layout, which also demands an SFX or SFX-L PSU

With our Noctua NH-L9i low-profile CPU cooler installed, the Phanteks' CPU delta T of 67°C in Compact mode was decidedly poor, being close to 10°C above other cases. This fell dramatically to just 53°C in Air Boost mode with two 120mm fans installed, so you're well-advised not to use Compact mode unless you have a low-end spec, especially as the GPU delta T fell by 5°C too. With an AIO liquid cooler at the helm, the CPU delta T of 37°C was the joint best on test, and the case was quieter than the Ssupd Meshlicious with the same hardware too.

Conclusion

It might not have the simplistic or niche appeal of other cases on test, with the likes of the Ssupd Meshlicious and Lian Li Q58 catering to specific audiences well, but the Phanteks Evolv Shift XT looks great on your desk and sometimes that's all that counts. Thankfully, as long as you kit it out with fans or a liquid cooler, it also performs well and can cope with large high-end graphics cards too.

SPEC

Dimensions (mm) 173 x 371 x 211 (W x D x H)
Material Aluminium, steel
Available colours Silver, black
Weight 5
Front panel Power, 1 x USB 3, 1 x USB 3.1 Type-C
Drive bays 1 x 2.5in
Form factor(s) Mini-ITX
Cooling 2 x 120/140mm roof fan mounts (fans not included)
Maximum CPU cooler height 72mm
Maximum graphics card length 324mm

VERDICT

A gorgeous and refreshing take on mini-ITX case design, although it gets very hot in Compact mode.

COOLING	FEATURES	OVERALL SCORE
27/30	12/20	78%
DESIGN	VALUE	
23/30	16/20	

SSUPD MESHLICIOUS

/ £100 inc VAT

SUPPLIER overclockers.co.uk

With a unique layout and design, blissfully easy hardware installation, decent water-cooling support and good views of your hardware, the Ssupd Meshlicious is definitely the mini-ITX case to beat. Its height is lower than that of the NZXT H1 V2, yet it has a smaller footprint than any other case on test and only costs £100. What's more, there are mesh panels available to boost thermal performance, should you wish to ditch the included tempered glass panel.

Available in black and white, the Meshlicious line-up is actually under Lian Li's banner as a new subsidiary brand, and the case sports an extraordinary amount of hardware support and customisation despite its size. It can house SFX or ATX PSUs, triple-slot graphics cards and 280mm radiators.

What's more, if you use a graphics card that's under 211mm in length in a horizontal (rather than vertical) mount, you get space for two 3.5in hard disks, plus three 2.5in SSDs, with the latter still available if you use a longer graphics card. If there's one complaint, it's that the graphics card riser cable is only PCI-E 3-compatible and a PCI-E 4 riser currently costs a whopping £90. As such, if you use a PCI-E 4 graphics card it's best to use one with a 16x interface, so you don't lose too much bandwidth by stepping down to PCI-E 3.

The motherboard tray moves too, catering for extra-deep graphics cards and shedding CPU cooler headroom from 73mm to 53mm. To make the most of the volume and to keep it as low as possible, Ssupd has also included an angled HDMI cable to reduce the clearance needed beneath the case, while also allowing the graphics card to move up and down to further optimise its position – that's a feature that would also benefit NZXT and Kolink's cases this month.

Only the outer shell of the case is riveted together, with the rest unscrewing to allow excellent access to all areas when tweaking the layout or installing your hardware. The panels are tool-free too, with the top section leaving behind a front panel that sports single USB Type-C and USB 3 ports.

With our air-cooled test kit installed, the CPU delta T was poor at 58°C due to the glass panel sitting this side, but this was only 5°C off the top spot, and still 9°C cooler than the Phanteks Evolv Shift XT in its fanless Compact mode. The GPU delta T was far better, thanks to the lone mesh panel on that side – only the Fractal Design Torrent Nano with an additional 120mm fan was significantly cooler.

With our liquid cooler installed, the Meshlicious managed the joint second best CPU delta T, outperforming the Lian Li Q58, Geek G1 SE and NZXT H1 V2. The downside to the cooling results, though, was that it was also the loudest case on test, allowing plenty of noise to leak out.

SPEC

Dimensions (mm) 166 x 245 x 360 (W x D x H)

Material Steel, glass, plastic

Available colours White, black

Weight 3.7kg

Front panel Power, 1 x USB 3, 1 x USB Type-C

Drive bays 2 x 2.5in (ATX PSU and full length graphics card), 7 x 2.5in (mini graphics card and SFX PSU), 2 x 3.5in (mini graphics card)

Form factor(s) Mini-ITX

Cooling 2 x 120/140mm front fan mounts (fans not included

Maximum CPU cooler height 73mm (53mm 4-slot graphics card mode)

Maximum graphics card length 336mm (211mm in small form factor mode)

DELICIOUS

+ Flexible interior
+ Excellent hardware support
+ Great value

MALICIOUS

– No fans included
– Very tall
– No PCI-E 4 riser cable included

Conclusion

While noise can be an issue due to its extensive use of mesh panels, the eye-catching Meshlicious has a near-perfect interior for its shape and orientation, and it has an unparalleled hardware support list. The fact it costs just £100 means it's by far the best mini-ITX case for newcomers and old hands alike, and for both air or water-cooled systems, although the former will benefit from an optional mesh panel. CPC

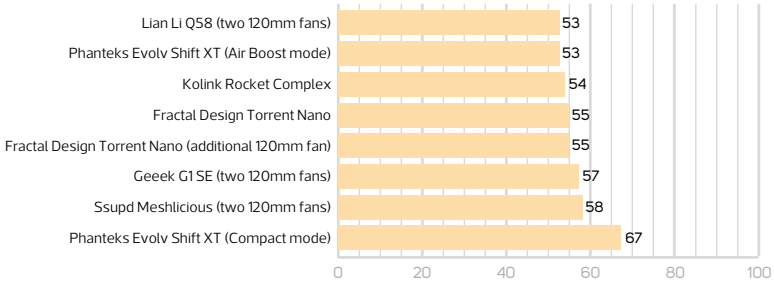
VERDICT

The most flexible mini-ITX case available right now, for a fantastic price.

COOLING	FEATURES	OVERALL SCORE
28/30	12/20	87%
DESIGN	VALUE	
28/30	19/20	

MINI-ITX CASE LABS TEMPERATURE AND NOISE RESULTS

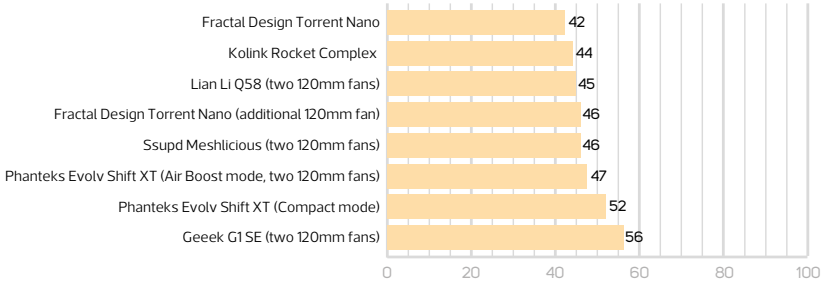
AIR-COOLED CPU DELTA T (°C)



Note: the NZXT H1 is absent from air-cooled graphs as it has a liquid cooler as standard

Lower is better

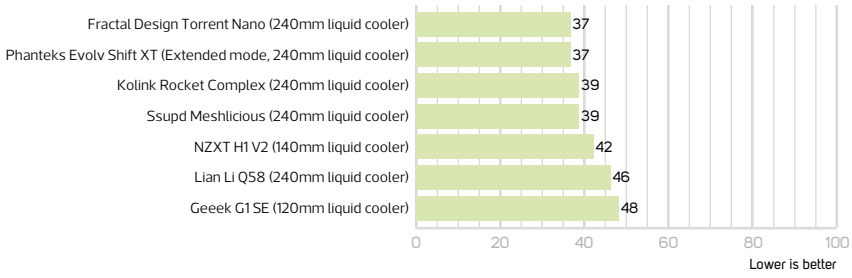
AIR-COOLED GPU DELTA T (°C)



Note: the NZXT H1 is absent from air-cooled graphs as it has a liquid cooler as standard

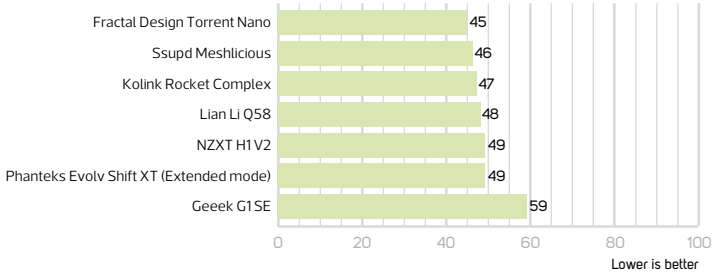
Lower is better

LIQUID-COOLED CPU DELTA T (°C)



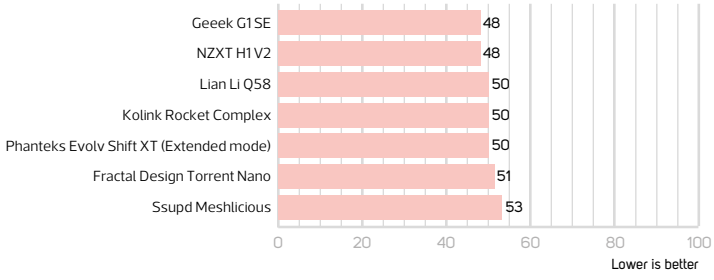
Lower is better

GPU DELTA T WITH LIQUID-COOLED CPU (°C)



Lower is better

NOISE LEVEL WITH LIQUID-COOLED CPU (DBA)



Lower is better

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LABS TEST

Button moon

Do you need a mouse with more than just a handful of buttons? **Edward Chester** puts seven multi-button gaming mice to the test

How we test

The recent trend for most gaming mice is to favour fewer features and a lightweight, comfortable design over lots of buttons and other extras. However, some games – and some gamers – just require more buttons. The most obvious example is the massively multiplayer online (MMO) genre of games, where many buttons are often desired in order to fire off a multitude of different commands and macros without having to take your hands away from their default keyboard and mouse positions.

More broadly, such mice can also be useful for other games where you need to do more than just point and click one or two buttons, and the extra buttons can of course be useful for desktop use too.

For a mouse to qualify as being multi-buttoned and MMO-ready, it needs to have at least two extra buttons over and above the standard left, middle/scroll and right buttons for your fingers, and two buttons for your thumb. Some designs take this approach to extremes, with large clusters of extra buttons under your thumb, while others have just one or two extras. Finding the right balance for your needs is a crucial consideration.

Note, we don't consider DPI switching buttons behind the scroll wheel to qualify unless they're genuinely easy to click in the heat of battle – most are set too far back to easily hit with a fingertip, or are too small to tap with the lower part of your finger. These combined criteria eliminate entire brands, including Cooler Master, BenQ/Zowie, Glorious PC Gaming Race and more, while many other companies offer up only one or two products that qualify.

To test the seven mice here, we checked off our usual criteria for design, comfort and build quality, as well as assessing the capabilities of the mice for a broad range of games, including first-person shooters and MMO-style games.

A lot of these mice tend to favour using a palm grip, as the sides have too many buttons to grip with your thumb, but others suit a more versatile range of grips and gaming applications.

Contents

- Corsair Nightsword RGB / p55
- Corsair Scimitar RGB Elite / p56
- Logitech G502 Hero / p57
- Razer Basilisk V3 / p58
- Razer Naga X / p59
- Roccat Kone XP / p60
- SteelSeries Rival 600 / p61

CORSAIR NIGHTSWORD RGB / £70 inc VAT

SUPPLIER scan.co.uk

Corsair is in a rare position in the gaming mouse market, as several of its mice offer enough extra buttons to qualify for this Labs test. Even its flagship, FPS-focused M65 Pro RGB has an extra thumb button and two top/DPI buttons. However, it's the Nightsword and Scimitar (over the page) that house the most buttons.

The Nightsword is primarily advertised as a 'tunable' mouse, which mainly refers to the fact that you can rearrange its internal weights system to fine-tune the mouse's balance to your liking. Given that the mouse already weighs 119g, however, our liking was to not add any weights at all.

Otherwise, the main defining feature of this mouse is its shape, which is akin to the Razer Basilisk V3. Although it has a wide protruding lower thumb rest, the main body is quite narrow and tapers to a fine point at the back. This means it works quite well for fingertip and claw grips for larger hands, but is better suited to small to medium-sized hands for its intended palm grip use.

Greatly aiding whichever grip style you use are the rubber sections on the back and sides. Compared with plain matt, gloss or even soft-touch plastic finishes, rubber provides a far more reliable level of grip in varied climate conditions. Conversely, the rather thick, stiff braided cable slightly hampers movements as it provides more pushback than lighter-grade cables.

SPEC

Weight 119g

Dimensions (mm) 62 x 129 x 43 (W x D x H)

Sensor PixArt PMW3391, 18,000 DPI, 50g acceleration, 400 IPS

Buttons 8 (left, right, scroll wheel press, 2 x index finger buttons, 3 x thumb buttons, 2 x top buttons)

Cable 1.8m, thick braided

Extras Weights system

For buttons, there are three main additions, with one extra thumb button, two extra index finger buttons and two buttons on the top. It's not that easy to distinguish between the top buttons and hit them accurately mid-game, but the other extras fall nicely to hand. It's not a vast selection of extras, but it proved enough for our most crucial extra button needs. What's more, the overall layout made for easy, reliable access to all the extra buttons, unlike some of the more button-festooned mice on test this month.

Unlike several contenders in this Labs test, the Nightsword's scroll wheel doesn't tilt or freewheel, but instead simply offers reliable rolling with a grippy surface, although it could do with slightly more defined bumps as it rotates. The Razer Basilisk V3 offers a similar style of mouse, but instead of extra index finger buttons, it includes a tilting and freewheeling scroll wheel. We found the Nightsword's combination better for gaming and the Razer more useful for desktop work.

Meanwhile, the styling of the Nightsword is fairly muted, but you still get four separate RGB lighting zones. Lights also show your DPI setting on the side of the mouse, just in front of the back/forward thumb buttons. It's a surprisingly useful addition to see your setting at a glance.

Inside, the Nightsword uses a trusty PixArt PMW3391 sensor that will keep up with all your extreme mouse movements. Indeed, overall, we found this a good all-round mouse that could turn its hand to a variety of gaming genres, not just MMOs. It's certainly not the best for fast, twitchy gaming and lacks the number of extra buttons of some mice on test, but it strikes a decent balance.

KNIGHT'S SWORD

+ Convenient set of extra buttons
+ Versatile shape
+ Lots of grippy rubber patches

VILLAGER'S PITCHFORK

− Rather heavy
− Not that many extra buttons
− Middling value

Conclusion

The Corsair Nightsword is a generally well-balanced multi-button mouse. Its handful of additional buttons fall easily to hand, and its shape works with a variety of grips and hand sizes, although the price is a bit high for the limited feature set. The Roccat Kone XP is the overall better option, but the Nightsword's rubber grips still make it worth considering if you're not bothered by the extra weight and don't need all the extra buttons.

VERDICT

A mouse with a well-balanced set of extra buttons, although it's a bit heavy.

DESIGN	FEATURES	OVERALL SCORE
15/20	12/20	77%
PERFORMANCE	VALUE	
25/30	25/30	

CORSAIR SCIMITAR RGB ELITE / £45 inc VAT

SUPPLIER overclockers.co.uk

Despite packing in a grid of 12 extra thumb buttons on its side, the Corsair Scimitar RGB Elite is the second cheapest mouse on test this month. That potentially solves the problem of some buyers not wanting to use this style of mouse for everything, but instead wanting a second mouse dedicated to MMO-style gaming. If you're only paying £45 rather than £70–£80, buying two mice is a much more palatable option.

What's more, although there are a few signs of a cost-cutting approach to mouse design here, such as the rather small feet and cheap-looking plastic on the underside, this mouse has a handful of premium touches. For a start, as the name suggests, you get RGB lighting in the form of an illuminated scroll wheel, plus a light that usefully shines back across the grid of thumb buttons.

The top of the mouse also has a pleasant soft-touch finish, while the addition of a rubber section on the right side of the mouse aids grip. On the underside and behind the grid of thumb buttons, you can also see flashes of the aluminium core used in the mouse's construction.

That grid can be slid back and forward, with a small Allen key bolt on the underside of the mouse tightening and loosening the sliding mechanism. Out of the box, the grid was set back and we found we preferred it fully forward to make as many of the buttons as accessible as possible.

However, regardless of where we set the grid, this arrangement of buttons just didn't quite work for us. The buttons are surprisingly easy to tell apart considering their small size, but in the heat of battle, it's very tricky to hit them accurately. Even just narrowing the points of each button more – as on the Razer Naga X – would improve this situation.

What's more, by having such a large cluster, you simply have nowhere to grip the mouse with your thumb. This is a mouse that's resolutely meant for a palm grip but, nonetheless, other mice on test prove you can find a better balance. What's more, even as a palm-grip mouse, we found it didn't offer the same palm support (which then allows freedom of movement for the thumb) as the Razer Naga X, Roccat Kone XP and SteelSeries Rival 600.

The upshot is that we simply couldn't game comfortably with this mouse in anything where remotely fast reflexes were required – it's categorically an MMO mouse only, not an all-rounder. Even in MMOs, we preferred having slightly fewer but more distinct and spread-out buttons, as on the Kone XP or Razer Basilisk.

The particularly frustrating aspect of this approach to adding many buttons is that Corsair hasn't added any extras anywhere else. You could add two extra index finger buttons and a tilting scroll wheel and do away with an entire row of thumb buttons. With this approach, you even miss out on conventional back and forward thumb buttons, until you manually assign these functions to the grid.

Conclusion

The usefulness of having one tightly packed cluster of overly small, grip-encumbering buttons is debatable here, and it puts the Scimitar in a small niche. Having slightly fewer buttons distributed around the mouse in more accessible positions makes for a much better setup in our experience. If you positively must have 12 extra thumb buttons for some tasks, this is a good-value second mouse that fits the bill. Otherwise, a multitude of other mice make for far better all-rounders.

SPEC

Weight 122g

Dimensions (mm) 77 x 120 x 42 (W x D x H)

Sensor PixArt PMW3391, 18,000 DPI, 50g acceleration, 350 IPS

Buttons 17 (left, right, scroll wheel press, 12 x thumb, 2 x top)

Cable 1.8m, thick braided

Extras Sliding thumb button cluster, RGB lighting

ELITE

+ Loads of thumb buttons
+ Surprisingly cheap
+ Movable button cluster

AMATEUR

– Thumb buttons too indistinct
– No back and forward buttons by default
– Nowhere to rest your thumb

VERDICT

Too many thumb buttons crammed into a small space make for a mouse with limited appeal, although it does offer good value.

DESIGN	FEATURES	OVERALL SCORE
11/20	15/20	69%
PERFORMANCE	VALUE	
18/30	25/30	

LOGITECH G502 HERO / £38 inc VAT

SUPPLIER currys.co.uk

The G502 has been around in various guises for nearly ten years, with the newest iteration adding Logitech's latest 25,000 DPI Hero optical sensor. Billed largely as a general-purpose gaming mouse, Logitech has packed in six extra buttons, making it more versatile than other more stripped-down gaming mice. It's also currently very cheap, with widespread discounted pricing putting it at less than half its original price.

The extra buttons comprise two to the front left of the conventional left-click button, an extra thumb button, a tilting scroll wheel and a single top-mounted button that's fairly easy to hit with the base of your middle finger. It's a well-balanced and easily accessible selection that ensures all the buttons stay well out the way when not needed, but remain easy to reach when called upon.

The big caveat here is the G502's heavy metal scroll wheel. The most egregious issue is its lack of a rubber coating, as the shiny bare metal is a terrible surface for providing reliable grip. There's also a wobbly, bouncy quality to the wheel. It presses in more before triggering its central button than most other mice and it has much more side-to-side play before triggering the tilt buttons too. Moreover, it's easier to accidentally trigger the tilt buttons in intense moments than on other tilting wheels.

The one saving grace of the wheel is the button that sits behind it, which removes the detents from the wheel to allow it to spin freely. It's great for scrolling through documents and web pages, although we've yet to find a use for it in games. An addition we do find useful is the set of DPI indicator LEDs that sit between the back/forward thumb buttons and the left-click button. These shine out through the gap between your thumb and index finger, making it easy to check your DPI setting at a glance.

Under the mouse is a magnetically attached panel, behind which can be stowed several weights that can add to the mouse's already considerable 121g weight, as well as fine-tune its in-hand balance point. Along with its terrible scroll wheel, the high weight of this mouse is one of its major drawbacks. The thick, stiff, braided cable is also an impediment to easy mouse movements, although it is at least good and sturdy.

On the plus side, this mouse's shape is excellent, providing comfortable grip for all styles, which is helped by thick rubber grip pads on its side. It's quite narrow though – particularly towards its back – so those with larger hands may find it a little cramped.

We can't fault the tracking performance either – Logitech's Hero sensor is right up there with the best and will keep up with the most extreme movements. We also really like the way Logitech's software recognises installed games and shows game functions – grenade select, jump, switch weapon and so on – directly, so you can assign them to buttons, rather than having to remember which key you've assigned to a function in each game.

HEROIC

- + Excellent extra button positions
- + Comfortable, versatile shape
- + Solid overall performance

VILLAINOUS

- – Too heavy
- – Slippery metal scroll wheel
- – Stiff cable

SPEC

Weight 121g

Dimensions (mm) 75 x 132 x 40 (W x D x H)

Sensor Logitech Hero optical, 25,000 DPI, 40g acceleration

Buttons 11 (left, right, scroll wheel press, 2 x scroll wheel tilt, 2 x side/thumb, under thumb, top, 2 x to the left of left-click)

Cable Fixed, 1.8m, thick braided

Extras 6 extra buttons, RGB lighting, side tilting scroll wheel, weights system

Conclusion

The Logitech G502 Hero is one of the most popular mice in the world and for good reason in terms of its overall versatility. Its extra buttons sit in useful positions and its freewheeling scroll wheel is great for productivity. However, when it comes to gaming, the weight of the mouse and its slippery metal scroll wheel significantly hold it back compared with current competition.

VERDICT

Versatile, comfortable and affordable, with excellent performance, but it's also heavy and the metal scroll wheel is slippery.

DESIGN	FEATURES	OVERALL SCORE
12/20	16/20	76%
PERFORMANCE	VALUE	
18/30	30/30	

RAZER BASILISK V3 / £70 inc VAT

SUPPLIER scan.co.uk

Like other models of Razer mice, the Basilisk is available in several different variants that use the same core shape but with different features. However, with this mouse, Razer has taken the differences between models to extremes. Opt for the Basilisk X and you get a stripped-down wireless mouse with only a handful of buttons. Choose the Basilisk Ultimate and you again get wireless convenience but with loads of buttons, a charging dock, adjustable scroll wheel resistance and much more.

Meanwhile, the Basilisk V3 we're reviewing here rather confusingly doesn't offer a wireless connection but does include 11 programmable buttons and a tilting scroll wheel – the latter can also be switched between notched or freewheeling modes. If you're just after lots of features without spending extra money for a wireless connection, this is the variant to get.

Running through those extra buttons, on the top, you'll find the standard left and right buttons, with two programmable buttons behind the scroll wheel, the rear one of which can be activated with the base of your middle finger. The further forward button defaults to switching the wheel between notched and freewheeling modes for easy document scrolling, but it can also be reprogrammed. The wheel also tilts left and right to trigger two more buttons.

Meanwhile, on the left side of the mouse is a more modest selection of buttons, with just a default set of back and forward thumb buttons, and one further button towards the front of the mouse that defaults to being a 'sniper' DPI switching button – it's a shame there's only the one extra thumb button here. Finally, on the underside of the mouse, there's also a profile switching button.

It's a decent combination of buttons that provides plenty of extra functions without making it too easy to hit buttons accidentally or totally compromising the ways in which you can hold the mouse. The scroll wheel helps significantly here, with its crisp and precise responses, unlike the mushy Logitech G502 Hero wheel.

The overall shape of the Basilisk works well for all grip styles, although for palm-grip use, it will only be suitable for those with small to medium-sized hands, as it lacks a bit of width and height at the back. There are also patches of rubber on the sides, which can help if you're using a fingertip grip.

With a weight of 101g, the Basilisk V3 is relatively light for this class of multi-button mouse, but it's still quite heavy when you consider the wider mouse market, with many first-person shooter-focused mice coming in at well under 70g. When it comes to styling, we also rather like the aggressive, pointed front and the subtle RGB lighting, which glows from the edges of the scroll wheel, the Razer logo and a strip that runs under the bottom edge of the mouse.

In games, the button combination proved a great balance for our needs, keeping out of the way during aggressive movements but still bringing a wide variety of functions to hand when needed. Razer's excellent Focus+ sensor also provides flawless tracking performance.

SPEC

Weight 101g

Dimensions (mm) 60 x 130 x 43 (W x D x H)

Sensor Razer Focus+, 26,000 DPI, 50g acceleration, 650 IPS

Buttons 11 (left, right, scroll wheel press, 2 x scroll wheel tilt, 3 x thumb, top)

Cable 1.8m, lightweight braided

Extras RGB lighting, freewheeling scroll wheel

SERPENT KING

+ Versatile shape
+ Great selection of extra buttons
+ Decent scroll wheel

SERVANT TO THE KING

– No extra index finger buttons
– Only one extra thumb button

Conclusion

The Razer Basilisk V3 is a great all-rounder of a mouse. Its shape suits a variety of hand sizes and grip styles and its extra buttons prove useful across a wide variety of games and non-gaming tasks. The Corsair Nightsword's extra index finger buttons proved more useful in-game than the Basilisk's freewheeling scroll wheel, but the Basilisk V3 still offers a decent balance.

VERDICT

Versatile and reasonably priced, the Razer Basilisk V3 is a great example of a multi-button mouse.

DESIGN	FEATURES	OVERALL SCORE
16/20	15/20	80%
PERFORMANCE	VALUE	
26/30	23/30	

RAZER NAGA X / £71 inc VAT

SUPPLIER scan.co.uk

The Razer Naga has been perhaps the most popular and well-known variant of the many-buttoned, MMO mouse for a long while. Like the Basilisk, the Naga is available in three variants with the same overall shape and key feature of its 12-buttoned thumb grid, but with some other key differences. The X is the cut-down, most affordable version, which has a fixed grid of 12 buttons.

With the Naga Trinity, Razer offers swappable sides that allow you to ditch the grid and instead have a more conventional two-button arrangement, or a circle of seven buttons. Meanwhile, the Naga Pro adds a wireless connection and also has interchangeable sides, but the middle option has a much more finger-friendly arrangement of six buttons in two rows.

It's the Naga X's fixed set of 12 thumb buttons that will either make or break the design for most users. Like the Corsair Scimitar, it's the simple fact that you have nowhere to rest or grip the mouse with your thumb that makes it feel a bit peculiar when it's in your hand. In this regard, it's only suited to palm-grip users who rely less on their thumbs to move the mouse.

Crucially, though, while we found the Corsair Scimitar didn't actually provide a particularly good grip on our palms, the Naga X does a better job, making it easier to free up the thumb for precise button mashing. The relatively low weight of 85g also helps, as it makes it easier to move around the Naga X than the Scimitar. The cable is a lightweight one, so it doesn't push back against your movements as much as the stiffer-cabled Scimitar.

The same story of generally better ergonomic design applies to the grid of buttons itself. The tips of the buttons come to a finer point than on the Scimitar, making it much easier to distinguish the gaps between them. Plus, the use of alternating angles for the tops of the buttons further helps you to tell them apart.

All that said, we still found that 12 buttons is simply too many to use in one place if you want to hit them accurately mid-game. We can't help but feel that losing one column or row of buttons, and adding the buttons in elsewhere on the mouse, would significantly aid usability. Indeed, that's a design element we loved about the no-longer produced Roccat Nyth, which had interchangeable buttons for its thumb grid, allowing you to arrange the grid as you best saw fit.

Elsewhere, the Naga X is quite a simple mouse. It has just a single button on its top and the scroll wheel doesn't tilt, plus there's no weights system, removable cable or any other extras. In some ways, this works in its favour, as it makes it light and generally decomplicates the rest of the mouse.

SPEC

Weight 85g

Dimensions (mm) 74 x 119 x 43 (W x D x H)

Sensor Razer 5G, 18,000 DPI, 40g acceleration, 450 IPS

Buttons 16 (left, right, scroll wheel press, 12 x thumb, 1 x top)

Cable 1.8m, lightweight braided

Extras RGB lighting

KING COBRA

- \+ Best 12-button design
- \+ Relatively light
- \+ Solid sensor performance

GUMMY SNAKE

- – 12 buttons crammed into one place
- – Few extras
- – Middling value

However, other mice on test have proved that having lots of thumb buttons is far from the only or best approach to adding extra buttons.

Conclusion

The Naga X does a decent job of making a huge grid of 12 thumb buttons on a mouse just about usable, comfortably beating the Corsair Scimitar RGB Pro when it comes to that specific design approach. However, its siblings with interchangeable sides offer much more versatility, and several other mice on test offer nearly as much utility, but with far more comfortable layouts that take advantage of your fingers as well as your thumb.

VERDICT

The best mouse with 12 thumb buttons we've tested, but that's not saying much.

DESIGN	FEATURES	OVERALL SCORE
14/20	14/20	72%
PERFORMANCE	VALUE	
22/30	22/30	

ROCCAT KONE XP / £80 inc VAT

SUPPLIER roccat.com

Roccat has certainly gone full steam ahead when it comes to RGB lighting recently, with the likes of the Roccat Magma keyboard and Roccat Torch microphone thoroughly outdazzling the competition. The brand-new Kone XP continues this trend, with the entire top section of the mouse being translucent and lit up by RGB strips underneath.

It's a bit much for our tastes – we're all for some subtle additions, but this is bordering on garish – ultimately, that's down to personal choice though. Far more universally appealing will be the huge amount of utility this multi-buttoned mouse brings to the table.

The Kone XP sports six extra buttons, along with a scroll wheel that tilts side to side to trigger two more buttons. The extra buttons consist of a second row of back/forward thumb buttons, a button on a protrusion that sits below the thumb (between the desk and the thumb), a single large button on the top and two buttons off to the side of the left-click button, as on the Logitech G502 Hero.

It's a superbly well thought-out selection that almost perfectly balances extra utility with accessibility while minimising accidental presses. The four thumb buttons are sufficiently large and well spaced to make it easy to accurately press the right one, and all of them also are well out the way when not needed, giving you room below to rest your thumb. Likewise, the two extra index finger buttons are well out of the way, but in the right place to hit when needed and easy to tell apart.

The same also goes for the lower thumb button, which we were generally able to avoid accidentally hitting, while also finding it easy to tap by just slightly rotating our thumb down. Even the tilting scroll wheel buttons were easy to not trigger accidentally. The top button is perhaps the least accessible, with it having quite a low profile, but you have plenty of other buttons available anyway.

What's most striking is this mouse's ability to make all these buttons accessible in a variety of grip styles, as some many-buttoned mice only really work well with palm-grip styles. That said, the space between the upper and lower thumb buttons is only just large enough – if you have fairly thick fingers, you might struggle to avoid accidental presses of the lower button.

This mouse doesn't employ rubber anywhere to aid grip, which slightly hampers its claw and palm-grip usage, but its shape largely compensates for this omission. Instead, the only major downside when it comes to easily gripping and flinging this mouse around your desk is its middling weight of 104g.

As for overall performance, the Kone XP can't be faulted, with its excellent sensor offering flawless tracking and its crisp button response hitting the right balance of being lightweight but not soft. The scroll wheel also has a particularly satisfying resistance to it, making for a very accurate feel when using it.

NORTHERN LIGHTS

- \+ Loads of extra buttons
- \+ Brilliantly incorporated extra buttons
- \+ Versatile shape
- \+ Loads of RGB

LAS VEGAS STRIP LIGHTS

- – Not all that light
- – Rubberised sides would be handy
- – Loads of RGB

SPEC

Weight 104g

Dimensions (mm) 76 x 126 x 40 (W x D x H)

Sensor Roccat Owl-Eye optical, 19,000 DPI, 50g acceleration

Buttons 15 (left, right, scroll wheel press, 2 x scroll wheel tilt, 4 x side/thumb, under thumb, top)

Cable Fixed, 1.8m, lightweight braided

Extras 10 extra buttons, RGB lighting, side tilting scroll wheel

Conclusion

The Roccat Kone XP is a truly fantastic all-rounder of a mouse. It expertly incorporates a multitude of extra buttons without completely compromising potential grip styles and suitability to different types of games. It's certainly outclassed for fast-paced gaming by fewer-buttoned, lighter mice, and technically some MMO mice do have more buttons, but none of them provides quite such a fine balance.

VERDICT

The one mouse to rule them all, the Kone XP is about as close to a perfect balance of extra buttons and general usability as you can get.

DESIGN	FEATURES	OVERALL SCORE
18/20	18/20	88%
PERFORMANCE	VALUE	
28/30	24/30	

STEELSERIES RIVAL 600 / £82 inc VAT

SUPPLIER overclockers.co.uk

The SteelSeries Rival 600 is very much marketed as an FPS and general gaming-focused mouse rather than a multi-buttoned MMO machine. However, thanks to the addition of an extra thumb button and a large, raised, top-mounted 'DPI' button that's easy to hit while gaming, it just qualifies for our testing.

It's this modest addition of buttons that will likely be the deciding factor for many buyers as to whether the Rival 600 suits their needs, as just two extra buttons may not be enough if you're seeking MMO-worthy functions. However, the advantage of only having a few extra buttons is that this mouse doesn't feel cramped. There's ample room on the thumb side to find a secure grip without accidentally hitting any buttons, while the top button is sufficiently out the way until you purposefully press your hand down on it.

If you're after a mouse that can provide a bit of extra utility, but still hold its own in games where you're flinging the mouse around and accidental presses are a matter of life or death, then the Rival 600 hits the mark. The only caveat is that the extra thumb button sits so far forward that we found it required a slight shift of grip to reach, despite having relatively large hands.

The Rival 600's cable terminates in a micro-USB plug that slots into the front of the mouse. It's great that the cable is replaceable in case of breakages, but the socket is so deep that many generic cables might not fit, if the original breaks. The lack of USB Type-C is a slight downside here too, but given this isn't a wireless mouse, it's not as if the cable can be used for anything else while the mouse is in use.

Meanwhile, the magnetically attached sides pop off to reveal four slots for adding weight to each side of the mouse. These can be used to add to the 96g starting weight and fine-tune the balance. If you're a firm believer in shedding all extraneous mouse weight, this isn't a feature you'll value, but the option is there if you prefer a weighty rodent. However, it's a shame SteelSeries doesn't offer alternative panels for the sides so you can fine-tune the shape/grip to your liking.

Speaking of grip, this mouse does suit all grip types and the rubber pads on the side are a huge boon for fingertip grip. However, it would benefit from having a slightly flatter right side, as the heavily sloped side isn't ideal for fingertip grip. It's easily the most comfortable mouse on test for palm grip, though, thanks to its sheer size – it's long and tall, so your hand can really drape onto it.

Meanwhile, the combination of the 12,000 DPI TrueMove 3 optical sensor and extra depth sensor combine to create utterly flawless tracking performance, while the quality of the buttons is top-notch, with no wobble or mushiness. The Rival 600 looks good too. The RGB backlit sections – sides of the scroll wheel, SteelSeries logo and two strips down the side of the middle – contrast attractively with the sleek matt black of the rest of the mouse.

SPEC

Weight 96g

Dimensions (mm) 62 x 131 x 43 (W x D x H)

Sensor TrueMove3+, 12,000 DPI, 50g acceleration, 350 IPS

Buttons 7 (left, right, scroll wheel press, 3 x thumb buttons, top)

Cable 1.8m, lightweight braided

Extras Weights system, removable sides, removable cable, extra depth sensor

UNRIVALLED

+ Two convenient extra buttons
+ Versatile shape
+ Excellent overall performance
+ Removable cable

UNRAVELLED

– Quite heavy
– Only two extra buttons
– Quite expensive

Conclusion

The addition of only two extra buttons makes it a stretch to consider the Rival 600 a multi-buttoned, MMO-ready mouse. However, its modest selection makes it pretty versatile. It can turn its hand just as well to fast-paced FPS games as genres that require a few extras. Its weight isn't to our liking, and other mice are better for specific game types, but it's a capable all-rounder. CPC

VERDICT

A modest button count but this is a versatile, if rather heavy, cross-genre mouse.

DESIGN	FEATURES	OVERALL SCORE
16/20	14/20	78%
PERFORMANCE	VALUE	
26/30	22/30	

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.

8-core system with integrated graphics

8-core CPU, basic gaming

Needs a micro-ATX or ATX case. We recommend a 450W 80 Plus Bronze power supply. See Issue 218, p76 for an example build guide.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	AMD Ryzen 7 5700G	scan.co.uk	**#218** p20	£290
CPU COOLER	AMD Wraith air cooler included with CPU	N/A	**#218** p20	£0
GRAPHICS CARD	AMD Radeon RX Vega 8 integrated into CPU	N/A	**#218** p20	£0
MEMORY	16GB (2 x 8 GB) Corsair Vengeance LPX Pro 3200MHz (CMK16GX4M 2B3200C16)	scan.co.uk	**#218** p78	£63
MOTHERBOARD	Asus TUF B450M-PLUS II (micro-ATX) with BIOS flash	awd-it.co.uk	**#218** p78	£85
STORAGE	500GB WD Blue SN570 (M.2 NVMe)	scan.co.uk	**#222** p20	£53
		Total £491		

1,920 x 1,080 gaming

6-core CPU, 1080p gaming

Needs an ATX case. We recommend a 500W 80 Plus power supply. See Issue 224, p14 for an example build guide.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	Intel Core i5-12400F	scan.co.uk	**#224** p14	£170
CPU COOLER	ARCTIC Freezer i13X	scan.co.uk	**#224** p76	£20
GRAPHICS CARD	AMD Radeon RX 6600 XT	overclockers.co.uk	**#220** p53	£420
MEMORY	16GB (2 x8 GB) Corsair Vengeance LPX DDR4 3200MHz (CMK16GX4M2E 3200C16)	scan.co.uk	**#224** p76	£62
MOTHERBOARD	Gigabyte B660 Gaming X DDR4 (ATX)	box.co.uk	**#224** p50	£138
STORAGE	1TB WD Blue SN570 (M.2 NVMe)	scan.co.uk	**#222** p20	£90
		Total £900		

UPGRADES				
SWAP GRAPHICS CARD	Nvidia GeForce RTX 3060 Ti	scan.co.uk	**#220** p55	£564
SWAP STORAGE	1TB ADATA XPG GAMMIX S50 Lite	cclonline.com	**#215** p43	£116

2,560 x 1,440 gaming system

10-core CPU, 1080p and some 2,560 x 1,440 gaming

Needs an ATX case. We recommend a 550-600W 80 Plus Bronze power supply.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	Intel Core i5-12600K	scan.co.uk	**#220** p19	£280
CPU COOLER	EK AIO 120 D-RGB (120mm AIO liquid cooler)	scan.co.uk	**#223** p40	£73
LGA1700 ADAPTOR	EK-AIO LGA1700 Upgrade Kit	ekwb.com	**#223** p40	£4
GRAPHICS CARD	Nvidia GeForce RTX 3060 Ti	scan.co.uk	**#220** p55	£564
MEMORY	16GB (2 x 8GB) Corsair Vengeance RGB Pro 3200MHz DDR4 (CMW16GX 4M2C3200C16)	scan.co.uk	**#221** p76	£70
MOTHERBOARD	Gigabyte Z690 Gaming X DDR4	scan.co.uk	**#222** p46	£200
STORAGE	1TB ADATA XPG GAMMIX S50 Lite	cclonline.com	**#215** p43	£116
		Total £1,307		

UPGRADES				
ADD SECONDARY STORAGE	Western Digital Blue 4TB	overclockers.co.uk	**#166** p54	£78

Mid-range gaming system

12-core CPU, smooth 2,560 x 1,440 gaming and 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	Intel Core i7-12700K	scan.co.uk	**#220** p18	£385
CPU COOLER	NZXT Kraken X53 (240mm AIO liquid cooler)	scan.co.uk	**#221** p76	£120
LGA1700 ADAPTOR	Asetek Premium Retention Kit LGA1700	overclockers.co.uk	**#221** p76	£5
GRAPHICS CARD	Nvidia GeForce RTX 3070 Ti	overclockers.co.uk	**#220** p43	£750
MEMORY	16GB (2 x 8GB) Corsair Vengeance RGB Pro 3200MHz DDR4 (CMW16GX 4M2C3200C16)	scan.co.uk	**#221** p76	£70
MOTHERBOARD	MSI MAG Z690 Tomahawk WiFi DDR4	cclonline.com	**#222** p48	£250
STORAGE	1TB ADATA XPG GAMMIX S50 Lite	cclonline.com	**#215** p43	£116
		Total £1,696		

UPGRADES				
ADD SECONDARY STORAGE	Western Digital Blue 4TB	overclockers.co.uk	**#166** p54	£78

Core component bundles cont ...

4K gaming system

12-core CPU, 4K gaming

Needs an 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	Intel Core i7-12700K	scan.co.uk	**#220** p18	£385
CPU COOLER	NZXT Kraken X53 (240mm AIO liquid cooler)	scan.co.uk	**#221** p76	£120
LGA1700 ADAPTOR	Asetek Premium Retention Kit LGA1700	overclockers.co.uk	**#221** p76	£5
GRAPHICS CARD	Nvidia GeForce RTX 3080 Ti	overclockers.co.uk	**#221** p48	£1,099
MEMORY	16GB (2 x 8GB) Corsair Vengeance RGB Pro 3200MHz DDR4 (CMW16GX4M2 C3200C16)	scan.co.uk	**#221** p76	£70
MOTHERBOARD	MSI MAG Z690 Tomahawk WiFi DDR4	cclonline.com	**#222** p48	£250
STORAGE	1TB WD Black SN850	box.co.uk	**#215** p49	£139

Total £2,068

UPGRADES

ADD SECONDARY STORAGE	4TB Western Digital Blue	overclockers.co.uk	**#166** p54	£78

Content creation system

16-core CPU, 1,920 x 1,080 gaming

Needs an E-ATX case with room for a 360mm all-in-one liquid cooler. We recommend a 750W 80 Plus Gold power supply.

COMPONENT	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
CPU	Intel Core i9-12900K	scan.co.uk	**#220** p16	£560
CPU COOLER	NZXT Kraken X73 (360mm AIO liquid cooler)	scan.co.uk	**#221** p76	£160
LGA1700 ADAPTOR	Asetek Premium Retention Kit LGA1700	overclockers.co.uk	**#221** p76	£5
GRAPHICS CARD	AMD Radeon RX 6600 XT	overclockers.co.uk	**#220** p53	£420
MEMORY	32GB (2 x 16GB) Corsair Dominator Platinum RGB 5200MHz DDR5 (CMT32GX5M2 B5200C40)	scan.co.uk	**#221** p76	£290
MOTHERBOARD	MSI MEG Z690 Unify	scan.co.uk	**#222** p50	£515
STORAGE	2TB WD Black SN850	scan.co.uk	**#215** p49	£269

Total £2,219

UPGRADES

SWAP GRAPHICS CARD	Nvidia GeForce RTX 3080 Ti	overclockers.co.uk	**#221** p48	£1,099
ADD SECONDARY STORAGE	4TB Western Digital Blue	overclockers.co.uk	**#166** p54	£78

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.

Mini-ITX

Motherboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
Intel Z690 (LGA1700)	Asus ROG Strix Z690-I Gaming WiFi	scan.co.uk	**#220** p22	£388
Intel Z590 (LGA1200)	Gigabyte Z590I Vision D	awd-it.co.uk	**#214** p18	£275
AMD B550 (AM4)	Asus ROG Strix B550-I Gaming	scan.co.uk	**#206** p44	£206

Cases

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
ALL-PURPOSE	Cooler Master MasterBox NR200P	scan.co.uk	**#206** p18	£100
TOWER	Ssupd Meshlicious	overclockers.co.uk	**#225** p51	£100
HIGH AIRFLOW	Fractal Design Torrent Nano	scan.co.uk	**#225** p45	£110
PREMIUM	Streacom DA2 V2	quietpc.com	**#214** p51	£203

Other components

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
LOW-PROFILE CPU COOLER	Noctua NH-L12S	scan.co.uk	**#219** p54	£55
SFX POWER SUPPLY	SilverStone SX750	scan.co.uk	**#219** p72	£130

ATX cases

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET RGB	Antec DF700 FLUX	scan.co.uk	**#214** p26	£80
SUB-£100 AIRFLOW	Corsair 4000D Airflow	scan.co.uk	**#222** p56	£90
COMPACT	Fractal Design Meshify 2 Compact	scan.co.uk	**#215** p20	£100
HIGH AIRFLOW	Fractal Design Meshify 2	scan.co.uk	**#212** p45	£140
MID-RANGE	Phanteks Eclipse P600S	overclockers.co.uk	**#202** p44	£140
SUB-£150	Fractal Design Define 7	scan.co.uk	**#204** p18	£160
PREMIUM HIGH AIRFLOW	Fractal Design Torrent RGB TG	scan.co.uk	**#225** p20	£219
LUXURY	Corsair iCUE 5000T RGB	scan.co.uk	**#224** p22	£350

Micro-ATX

Motherboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
AMD B450 (AM4)	Asus TUF B450M-PLUS II	awd-it.co.uk	**#218** p76	£75
AMD B550 (AM4)	MSI MAG B550M Mortar	ebuyer.com	**#204** p42	£140

Cases

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET	Kolink Citadel Mesh RGB	overclockers.co.uk	**#218** p26	£63

Networking

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET ROUTER	Belkin RT3200-UK	currys.co.uk	**#216** p52	£90
ROUTER	Asus RT-AX68U	scan.co.uk	**#216** p51	£170
MESH ROUTER	Asus AiMesh AX6100	amazon.co.uk	**#196** p54	£270
WI-FI ADAPTOR	TP-Link Archer TX3000E	overclockers.co.uk	**#196** p58	£60
DUAL-BAY NAS BOX	Synology DS220j	box.co.uk	**#200** p22	£154
DUAL-BAY MEDIA NAS BOX	Synology DS218play	box.co.uk	**#174** p34	£179
2.5 GIGABIT DUAL-BAY NAS BOX	QNAP TS-231P3	ebuyer.com	**#212** p25	£283

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

Monitors

Up to 25in

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
24IN, 144HZ, IPS, 1,920 X 1,080, F, G	AOC 24G2U	overclockers.co.uk	#214 p28	£190
25IN, 240HZ, IPS, 1,920 X 1,080, F, G	Acer Predator XB253Q	box.co.uk	#209 p57	£300
25IN, 360HZ, IPS, 1,920 X 1,080, F, G	Asus ROG Swift PG259QN	amazon.co.uk	#212 p20	£543

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	£230
27IN, 240HZ, IPS, 1,920 X 1,080, F, G	Asus TUF Gaming VG279QM	ebuyer.com	#209 p60	£352
27IN, 165HZ, VA, 2,560 X 1,440, F, G	AOC CQ27G3SU	box.co.uk	#223 p45	£322
27IN, 240HZ, TN, 2,560 X 1,440, F, G	AOC AG273QZ	overclockers.co.uk	#202 p27	£590
27IN, 240HZ, IPS, 2,560 X 1,440, F, G	Alienware AW2721D	dell.com	#212 p21	£700
28IN, 144HZ, IPS, 3,840 X 2,160, F, G	AOC U28G2XU	amazon.co.uk	#221 p29	£569

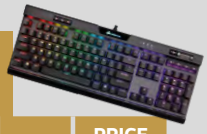
Over 28in

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
31.5IN, 60HZ, VA, 4K, F	iiyama ProLite XB3288UHSU	scan.co.uk	#205 p43	£385
32IN, 144HZ, VA, 2,560 X 1,440, F, G	iiyama G-Master GB3266QSU	ebuyer.com	#224 p30	£377
32IN, 165HZ, IPS, 2,560 X 1,440, F, G	LG UltraGear 32GP850	overclockers.co.uk	#220 p38	£480
34IN, 144HZ, IPS, 3,440 X 1,440, W, F	iiyama G-Master GB3461WQSU	overclockers.co.uk	#206 p53	£450
34IN, 144HZ, IPS, 3,440 X 1,440, W, F, G	LG UltraGear 34GN850	overclockers.co.uk	#206 p55	£899
38IN, 144HZ, IPS, 3,840 X 1,600, W, F, G, HDR	LG UltraGear 38GN950	overclockers.co.uk	#208 p30	£1,349
32IN, 144HZ, IPS, 3,840 X 2,160, F, G, HDR	Asus ROG Swift PG32UQX	scan.co.uk	#218 p54	£3,299

Non-gaming

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
27IN, 75HZ, IPS, 2,560 X 1,440, F	LG 27QN880	box.co.uk	#210 p26	£399

Peripherals and audio



Gaming keyboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET TKL	SteelSeries Apex 3 TKL	currys.co.uk	#221 p59	£48
OPTICAL ESPORTS	Asus ROG Strix Scope RX	amazon.co.uk	#209 p43	£70
MECHANICAL MMO	Corsair K95 RGB Platinum	scan.co.uk	#164 p26	£180
PREMIUM TKL MECHANICAL	Corsair K70 RGB TKL	scan.co.uk	#214 p31	£140
PREMIUM MECHANICAL	Corsair K70 RGB Pro	overclockers.co.uk	#225 p30	£170
LUXURY WIRELESS MECHANICAL	Razer BlackWidow V3 Pro	overclockers.co.uk	#208 p60	£180

Gaming mice

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET GAMING	Corsair M55 RGB Pro	box.co.uk	#200 p24	£35
FIRST-PERSON SHOOTER	Glorious PC Gaming Race Model O	overclockers.co.uk	#215 p57	£45
AMBIDEXTROUS	Razer Viper 8K	currys.co.uk	#215 p59	£60
MULTI-BUTTON	Roccat Kone XP	roccat.com	#225 p60	£80
WIRELESS	Razer Viper Ultimate	amazon.co.uk	#217 p54	£83
PREMIUM WIRELESS	Razer Deathadder V2 Pro	ebuyer.com	#210 p28	£100
ULTRA LIGHTWEIGHT	Roccat Burst Pro	scan.co.uk	#211 p28	£48
PREMIUM LIGHTWEIGHT WIRELESS	Logitech G Pro X Superlight	currys.co.uk	#217 p52	£119

Peripherals and audio cont ...

Game controllers

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
RACING WHEEL	Logitech G29 Driving Force	currys.co.uk	#202 p50	£249
PREMIUM GAMEPAD	Razer Wolverine V2 Chroma	razer.com	#221 p30	£149
BUDGET FLIGHT STICK	Logitech Extreme 3D Pro Joystick	currys.co.uk	#207 p52	£37
FLIGHT STICK	Thrustmaster T.16000M FCS HOTAS	scan.co.uk	#207 p56	£100

Gaming headsets

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET STEREO	Roccat Elo X Stereo	scan.co.uk	#210 p56	£40
STEREO	Epos | Sennheiser GSP 300	amazon.co.uk	#210 p54	£67
WIRELESS	Corsair Virtuoso RGB Wireless	ebuyer.com	#204 p50	£115
PREMIUM WIRELESS	Razer BlackShark V2 Pro	scan.co.uk	#211 p26	£149

Speakers

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
STEREO	Edifier R1280DB	overclockers.co.uk	#224 p59	£110

Non-gaming keyboards

CATEGORY	NAME	SUPPLIER	ISSUE	PRICE (inc VAT)
WIRELESS 84-KEY ELECTRO-CAPACATIVE	Niz Mini 84 Pro	keyboardco.com	#220 p29	£165
WIRELESS TKL MECHANICAL	Keychron K2 Version 2	keyboardco.com	#208 p57	£84
TKL MECHANICAL	Filco Majestouch Convertible 2 Tenkeyless	keyboardco.com	#203 p55	£140
BUCKLING SPRING MECHANICAL	Unicomp New Model M	keyboardco.com	#219 p26	£129

PCs and laptops

Pre-built PC systems

CATEGORY	NAME	CPU	GPU	SUPPLIER	ISSUE	PRICE (inc VAT)
AMD APU PC	Wired2Fire Ultima Ryzen Gamestation	AMD Ryzen 5 5600G	Integrated AMD Radeon RX Vega 7	custompc.co.uk/W2F	#222 p36	£692
BUDGET GAMING	Wired2Fire Phoenix Intel – Powered by MSI	Intel Core i5-12400F	Nvidia GeForce RTX 3060	custompc.co.uk/Phoenix	#224 p38	£1,103
MID-RANGE GAMING	PC Specialist Magnus Supreme	Intel Core i5-12600KF	Nvidia GeForce RTX 3070 Ti	custompc.co.uk/Magnus	#223 p26	£1,499
QUIET GAMING	Gladiator Nocturnal	Intel Core i5-12600K	Nvidia GeForce RTX 3070	custompc.co.uk/Nocturnal	#225 p36	£1,799
4K GAMING	PC Specialist Magnus Pro	Intel Core i7-12700K	Nvidia GeForce RTX 3080 Ti	custompc.co.uk/MagnusPro	#225 p34	£2,499
WATER-COOLED ALDER LAKE	CyberPower Hyper Liquid Infinity X129	Intel Core i9-12900K	Nvidia GeForce RTX 3080	custompc.co.uk/CPHL	#222 p34	£3,900
DREAM PC	Scan 3XS Barracuda	Intel Core i9-10980XE OC to 4.3GHz	Nvidia GeForce RTX 3090	custompc.co.uk/Barracuda	#145 p58	£14,456

Laptops

CATEGORY	NAME	CPU	GPU	SCREEN	SUPPLIER	ISSUE	PRICE (inc VAT)
BUDGET GAMING	Lenovo Legion 5 Pro	AMD Ryzen 7 5800H	Nvidia GeForce RTX 3070 Laptop	16in, 2,560 x 1,600 IPS 165Hz G-Sync	custompc.co.uk/Legion5Pro	#222 p32	£1,499
ULTRA PORTABLE GAMING	Razer Blade 14	AMD Ryzen 9 5900HX	Nvidia GeForce RTX 3070 Laptop	14in 1,920 x 1,080 IPS 144Hz	custompc.co.uk/Blade14	#220 p40	£2,120
ULTRA PORTABLE GAMING + EGPU DOCK	Asus ROG Flow X13 GV301	AMD Ryzen 9 5980HS	Nvidia GeForce GTX 1650 Max-Q (laptop) / RTX 3080 Laptop (dock)	13.4in 1,920 x 1,200 IPS 120Hz	custompc.co.uk/ROGFlow	#219 p28	£2,956

RICK LANE / INVERSE LOOK

PASS AND FUTURE

Rick Lane asks if the success of Microsoft's Game Pass subscription service will change the types of games we play

The console battle between Microsoft and Sony has had a knock-on effect on PC gaming for years. Remember Games for Windows Live? That service existed purely due to Microsoft's attempt to Xbox-ify the PC, unifying all its gaming services under one, terrible banner.

Games for Windows Live was a miserable failure, but Game Pass, Microsoft's new subscription service, is not. The platform lets players access a wide range of PC and Xbox games for a set monthly fee (roughly equivalent to an Amazon Prime subscription) and has proved hugely popular, with Xbox head Phil Spencer announcing it had 25 million subscribers as of January this year.

This success has all kinds of ramifications for PC gaming. Some are positive, such as players accessing a large number of games for a relatively small fee. Others are more concerning, such as players getting distanced from ownership of their own media. But what intrigues me most about the potential shift from digital purchases to subscription services is how they might affect the games we play.

Currently, the most popular games are either massive, open-world single-player experiences, or online, microtransaction-based games such as Apex Legends and Call of Duty: Warzone. There are many reasons why these games are popular, but one is that they offer good value for money.

A game such as Elden Ring or Assassin's Creed Valhalla offers dozens of hours of play for the £50 you spend on them, while Warzone and Apex potentially offer hundreds of hours of play for little investment. But developing such games makes considerably less sense for a subscription service, where the key draw isn't the size or the price of individual games, but the breadth of the library itself.

> The key draw isn't the size or the price of individual games, but the breadth of the library itself

When you subscribe to Netflix, you want a choice of plenty of good-quality films and TV series. The length of an individual series doesn't really matter, because you've always got another one lined up to watch.

It follows that the same would be true for a gaming subscription service. You'll want to explore as much of that large library of games as possible, and if a game doesn't grab you quickly and give you a consistently enjoyable experience, there's no sunk cost holding your attention to ransom.

Assuming Game Pass continues to be successful, I reckon the types of games available on it will change over time. Developers working for Microsoft will shift from making 80-hour games that take many years to develop, to creating a larger quantity of shorter experiences that add greater face value to the library.

Whether or not this is good or bad largely depends on how much you like massive open-world games (and I don't think those experiences will vanish entirely). I'm up for seeing developers given the chance to experiment with smaller projects that release quicker, and being able to sample a wider range of experience, rather than losing an entire month's worth of evenings to a single game. CPC

Rick Lane is Custom PC's games editor @Rick_Lane

God of War / £39.99 inc VAT

DEVELOPER Santa Monica Studio / **PUBLISHER** PlayStation PC LLC

After five years of PS4 exclusivity, Sony has released its Norse epic God of War on PC. It sees players assume the role of Kratos, who, after several games spent mercilessly slaughtering the pantheon of Ancient Greek myth, has settled down for a quiet life in the realms of the Norse gods. After the death of his human wife Faye, Kratos sets out with his son Atreus on a personal quest to honour her final wish to scatter her ashes on the peaks of Jotunheim, the land of giants.

What follows is a surprisingly personal tale of loss, parenthood and coming to terms with one's past. The game centres around the frictional relationship between Kratos and Atreus, the latter desperate to prove his worth to his father, and the former struggling with grief and his responsibilities as a father. It may sound trite, but it's handled with impressive subtlety.

Together, Kratos and Atreus struggle through the epic backdrop of Midgard and other Norse realms, which have been broken by the exact kind of deific conflict that Kratos used to be at the centre of. A semi-open world, God of War balances its storytelling with a mixture of light exploration and heavy combat.

Central to both is Kratos' Leviathan Axe, one of the best video game tools ever designed. Kratos can throw the axe to activate switches, create handholds and jam the vast gears of godly machinery, often creating pathways that Atreus can use to retrieve items or help complete puzzles.

In combat, the Leviathan Axe acts both as a melee and ranged weapon. Kratos can slice enemies into sushi with almighty swings, or throw it at an enemy to freeze them in place while he batters other foes with his massive fists. Kratos can also recall the axe to his hand at any time, which is immensely satisfying.

Indeed, the axe is almost too well designed. When Kratos unlocks a (sort of) new weapon in the game's final third, it doesn't feel like the upgrade it should. This is one of God of War few design flaws, alongside an ending that feels rather muted after the hours of epic drama.

The PC port doesn't add any new content, but the improved visuals and performance make it the best version of the game available. New features include 4K graphics support, unlocked frame rates and support for Nvidia DLSS, among other technical improvements. If you missed God of War on PS4, the PC version is a must-play. The visual updates keep it current with the best-looking PC games, while its combat and storytelling remain as gripping as they were in 2018.

RICK LANE

GOD OF WAR

- \+ Great port
- \+ Visually stunning
- \+ Excellent storytelling
- \+ Incredible combat

GOD OF POOR

- – Later weapons disappoint compared with Leviathan Axe
- – Ending slightly muted

/ VERDICT

The best version of one of the PS4's best exclusives, God of War is a triumph of game design.

OVERALL SCORE

92%

Elden Ring / **£49.99** inc VAT

DEVELOPER From Software / **PUBLISHER** Bandai Namco

Custom PC PREMIUM GRADE

ELDEN RING

+ Vast, beautifully crafted open world
+ Deep and flexible RPG systems
+ Peerless combat
+ Constant surprises and discoveries

ELDEN WRONG

– Awkward menu controls
– Some clipping issues

From Software's challenging, enigmatic RPGs have for years enraptured players with their combination of meticulously designed worlds, rich combat systems, cryptic storytelling and ferocious boss fights. All its games excel, and at least two – Dark Souls and Bloodborne – are generally considered masterpieces.

Elden Ring outdoes them all. From Software's latest fantasy adventure takes the ingredients that made its previous games so captivating, and combines them with a true open world that astonishes in every sense imaginable – its scale, its beauty, its depth (both figurative and literal), and its capacity to surprise and delight over dozens of hours.

This success was by no means guaranteed. Crucial to the design of Dark Souls and Bloodborne are their intricate geometry. Lordran and Yharnam are gigantic spatial puzzles that players slowly unpick, discovering shortcuts and secrets that help them to navigate and progress with greater ease. While not strictly linear, they're designed to funnel players in specific ways, ensuring they (mostly) encounter the right bosses at the right time.

With the expanse of a true open world, that distinctive sense of progression and achievement could easily be lost. Instead, Elden Ring's sprawling fantasy realm serves only to enhance the essence of From's design philosophy. Not only are the secrets and surprises exhibited in previous games preserved, but they're more numerous and larger in scale. In addition, the open world helps to make Elden Ring more accessible, providing a pressure valve for players frustrated by one of the game's many formidable bosses.

Players start their adventure by picking one of several classes, ranging from warriors to sorcerers to the near-naked Wretch whose only weapon is a large, caveman-like club. Whatever your choice, all players end up washed up on the shores of Limgrave, one of several massive regions of the realm known as the Lands Between. You are a Tarnished, one of a tribe of spurned outcasts who are being recalled to their homeland by a force known as Grace, with no further directive other than the vague goal of reforging the Elden Ring.

There's a clear progression path through Elden Ring's world, and the game hints at it in the form of golden arcs that drift away from the various checkpoints known as Sites of Grace. However, it soon becomes clear that the journey ahead is a daunting one, with a literal difficulty gate guarded by siege weapons and a towering giant. Fortunately, there are a host of landmarks around Limgrave that call to be explored, from giant castles teetering on rocky precipices, to gnarled statues that, when touched, guide you to hidden catacombs.

Elden Ring wants you to explore, but it also wants you to discover its world for yourself. It rarely provides marks on the map to pursue, instead letting the environment pull you towards sites of interest using visual and audio cues. Gradually, you'll build up your own mental map, and know

what a certain structure or sound represents. In typical From Software fashion, sometimes these cues are misleading. A treasure chest in a tower or a melancholy song carried on the wind may lead you not to rewards, but into a trap.

What is guaranteed on your travels, however, is breathtaking sights. The Lands Between is a realm of desolate beauty, its long and torrid history written across its cracked landscapes and crumbling ruins. Some areas, such as the stunning misted valley of Liurnia, whose azure panoramas resemble a romantic artwork brought to life, retain much of that beauty. Others, such as the crimson hellscape of Caelid, have fallen fully into corruption.

Yet whether beautiful or foreboding, these landscapes are always dangerous, roamed by swarthy mercenaries, magic-wielding soldiers, innumerable types of horrible dog and bizarre, copper-headed contraptions that shoot fire from their mouths. Every foe you face can kill you in seconds if you aren't vigilant, while most bosses will attack you mercilessly as you learn how to defeat them. From Software is a master of creating unpredictable, devastating opponents, and some of them, such as Margit the Fell Omen and Godrick the Grafted, are among the toughest the studio has designed.

But Elden Ring is not like Sekiro, which demanded you battle these foes with precision blocks and counters. Instead, it caters to a wide range of fighting styles. Sorcery isn't merely a valid character path, but a highly alluring one, letting you access a huge range of incredible powers, summoning a vast magical blade with Carian Greatsword, or firing a devastating beam of energy with Comet Azur.

Melee characters get a taste of magic too, through special abilities known as Ashes of War. These let you blast enemies with powerful vortices, or chill them to the bone with a blade coated in magical ice. You can also call for help against bosses in various ways, such as summoning other players to fight alongside you, or using Spirit Ashes, which let you conjure up wolves, skeletons and other creatures during battle.

Perhaps the most significant new mechanic is Torrent, the magical steed you can summon in most places of the game world. Not only does Torrent help you to get around the world faster, but he can also be used in many combat situations, including certain bosses. Indeed, boss encounters that allow for Torrent are some of the most spectacular in the game, seeing you square off against mounted knights wielding giant halberds, or huge dragons that you'll fight across entire lakes and valleys, avoiding their deadly plumes of fire.

The result of all this is a game that constantly surprises you, where even the smallest enemy can provide a thrilling combat encounter, and where bravery and ingenuity is rewarded with more opportunities to be brave and ingenious. It's not perfect, however. Perhaps the biggest issue is the game's UX design. Menus are heavily nested, and navigating them isn't remotely intuitive. The button you press to open the map, for example, is different from the one you press to close it. Also, the game's environmental object collision can be inconsistent. It's one thing for an enemy to beat you to a pulp, another when it beats you to a pulp through a wall.

More broadly, little here is genuinely new, and most of it has either been a feature of open-world games or From Software's own titles, for many years. But this is precisely what makes the game so fascinating. From Software's suffusion of these elements creates an experience that feels radical, because the studio's own ideas often fly in the face of traditional open-world design. Elden Ring is frequently obscure and idiosyncratic, happily letting you wander into an area for which you're completely unprepared.

But puzzling out the many conundrums is exactly what makes Elden Ring so compelling, and it keeps the surprises coming for far longer than most games of its ilk. It's undoubtedly one of the best open-world games ever made, better than The Witcher 3 and tussling with Nintendo's Breath of the Wild. And if somehow it isn't the best game of 2022, then we're incredibly excited to play what beats it.

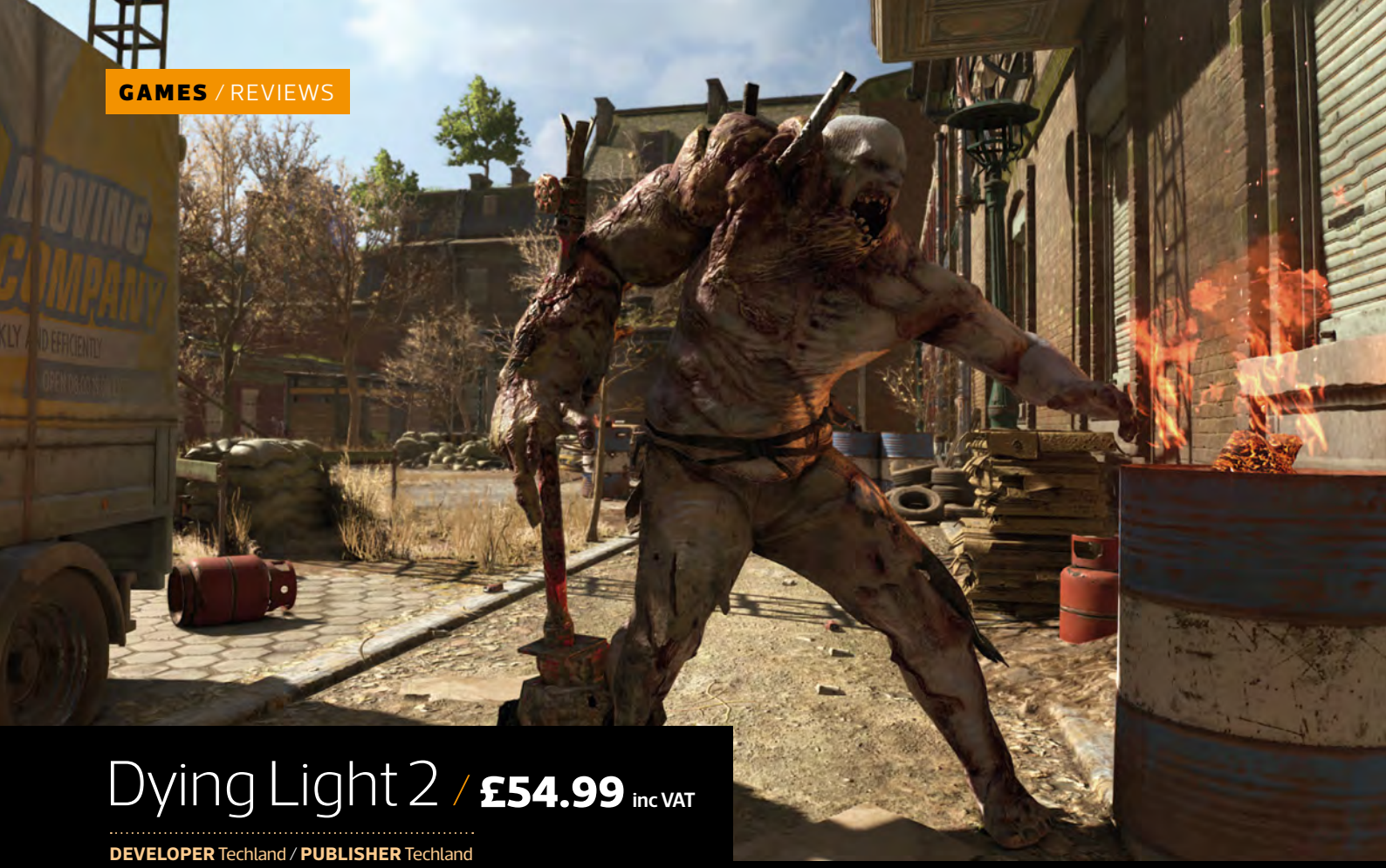
RICK LANE

/ VERDICT

Huge, formidable and endlessly gripping, Elden Ring is From Software's magnum opus.

OVERALL SCORE

96%



Dying Light 2 / **£54.99** inc VAT

DEVELOPER Techland / **PUBLISHER** Techland

Dying Light 2 doesn't want to be a better game than its predecessor; it wants to be a more important one. The sequel to Techland's surprise 2015 hit strives to blend the free-running, zombie survival simulation of the original with a Witcher 3-style narrative, placing heavy emphasis on characterisation and world-changing choices. Unfortunately, Techland lacks the storytelling chops of The Witcher 3 developer CD Projekt Red, and the result is a ponderous mess that lacks much of what made the original game compelling.

The sequel's story takes place around 20 years after the original, centring around a young, white man called Aiden. Working as a 'Pilgrim', a sort of post-apocalyptic postman, Aiden is travelling the game's world in search of his sister Mia, which leads him to a large, walled city named Villador.

The city is primarily controlled by two factions, the orderly yet controlling Peacekeepers and the more liberal, yet reckless Bazaar. Both factions offer to assist Aiden in his search, if only he helps them in the fight against their rival for power.

This faction system is supposedly the game's big new feature. Prior to release, developer Techland promised a highly dynamic faction system, in which multiple factions could control different parts of the city depending on player choices and events within the city itself. The final version, however, is much more static and binary, built upon two different choice systems that don't really interrelate.

The first system comprises traditional narrative-tree choices that alter the broad direction of the main story and individual side quests. The second involves the city's amenities, such as water towers and power junctions found in various locations across the map. These resources can be diverted to one of the two factions for environmental rewards. Give these resources to the Bazaar, and they'll provide aids to your parkour, such as ziplines and airbags. The Peacekeepers, meanwhile, will furnish the streets with deployable traps and other gizmos that will help you in combat.

It's fun to play with these tools, but this system is ultimately nowhere near as advanced as the complex choice matrix Techland originally promised. This would be less an of an issue if the story was well written, but Techland's attempt to Witcher-up its storytelling is at best a mixed success. Characters are more detailed than in The Witcher 3, and the quests are more dialogue heavy, with almost every encounter triggering a lengthy conversational cutscene as they relate their personal tale of woe to you.

Unfortunately, Techland's writing lacks the subtlety and personality needed to make this approach work, with conversations lacking snap and rhythm. Having more story doesn't necessarily make for a better story, and the result here is reams of bloated, hollow scripts – you mostly just want to skip through it all.

It's a shame Techland's narrative ambitions don't pay off, but it wouldn't be a disaster if Dying Light 2 maintained the quality of the original game elsewhere. Sadly, this isn't the case. The first game made a strong distinction between day and night. In the day, the streets were prowled with vast hordes of zombies, and falling off a rooftop could mean death. At night, not even the rooftops were safe, as they were prowled by fast, powerful zombies called Volatiles who could kill you easily.

In Dying Light 2, both night and day are much less dangerous. In the sequel, zombies stay inside during the day and inside at night. The game's missions are built around this concept, which means you spend most of your time avoiding zombies rather than engaging with them.

Exploring interiors is particularly underwhelming, revolving heavily around a rudimentary stealth system that offers little to keep the player involved.

There is one cool concept bundled up in all this, which is that staying out of UV light for too long will result in Aiden turning into a zombie himself. However, this problem is easily mitigated through a bunch of UV-related consumables.

You can, of course, fight through these scenarios if you choose, which is undoubtedly the more enjoyable approach. However, combat is also a step back from the first Dying Light. Basic abilities such as kicks are far less satisfying than in the first game, while the many traps that litter the environment are undermined by a weightless physics engine. There are also no firearms, which makes for a one-note combat system. Hitting zombies with melee weapons is satisfying in a grisly way, but it's rare that you find a weapon that feels truly special.

Even the parkour, the game's central mechanic, isn't as well executed as in the original. Running around rooftops is still broadly enjoyable, but Dying Light 2 saddles its early game with a strict stamina bar that severely limits your ability to climb. By the time you've upgraded Aiden so that climbing is no longer a major obstacle, you'll have acquired the paraglider, which is necessary for exploring the second act's skyscrapers, but largely mitigates both climbing and avoiding zombies, essentially letting you circumvent the game.

Not everything about Dying Light 2 is a misfire. The city is beautifully designed and generally fun to explore. The soundtrack is excellent, particularly the way in which the music layers in more motifs the longer you maintain your parkour flow. Many of the quests are well designed, with multiple stages and interesting twists.

One highlight sees you climbing a giant wind turbine to plant explosive charges on it. When those charges only partially destroy the turbine, you must rush back with a timed explosive and plant it at the top before it goes off. Some of the more substantial side quests are also fun to pursue, such as one where you help a dodgy merchant to acquire some military equipment from an abandoned underground car park.

Dying Light 2 is undoubtedly at its best in its bigger set-pieces, where all the facets of its design point in the same direction. In general play, however, it's a confused and compromised mess. In trying to create a more curated, narrative-driven experience, Techland has hamstrung the dynamic systems that made the first game so much fun, leaving far less space for players to create their own tales of zombie survival.

RICK LANE

LIGHT

- \+ Well-designed open world
- \+ Parkour is still fun
- \+ Some good quests

DYING

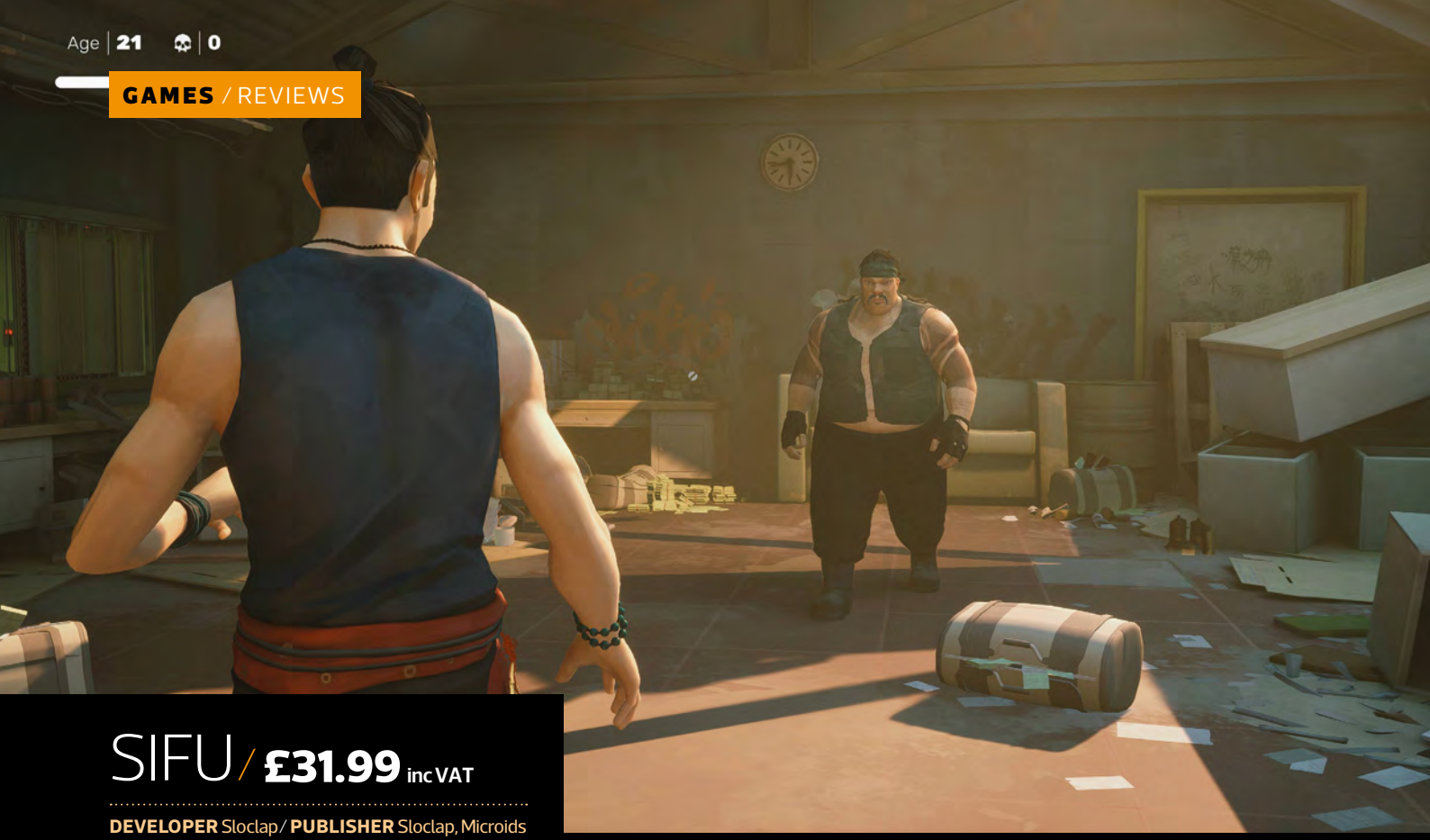
- – Wonky narrative emphasis
- – Underwhelming choice system
- – Misguided day/night mechanic
- – Parkour and combat less entertaining than the first game

/ VERDICT

While it has moments of inspiration, Dying Light 2 is overall a big step back for Techland's zombie-parkour series.

OVERALL SCORE

54%



SIFU / £31.99 inc VAT

DEVELOPER Sloclap / **PUBLISHER** Sloclap, Microids

KUNG FU

+ Stylish visuals
+ Complex, satisfying combat
+ Novel aging mechanic

FENG SHUI

− Unpleasantly difficult
− Refuses to adequately instruct you

Sifu is a playable love letter to martial arts movies, a fast-paced and uncompromising action game that combines a rich and complex combat system with an emphasis on replayability. The story is a straightforward revenge plot that sees you prowling the streets of Hong Kong in search of five rogue martial arts masters responsible for killing your father. Each level sees you working through nightclubs, museums and back alleys, battling large groups of enemies in quickfire combat.

The combat systems blend Sloclap's previous work in multiplayer martial arts game Absolver with the counter-based combat of Sekiro: Shadows Die Twice. Learning when to attack, which attacks to block and which to dodge is crucial. Enemies can be defeated by reducing their health to zero, but the more effective way is to break their guard, opening them up to a choreographed finishing blow that provides a brief window to plan your next move.

The system does a fantastic job of replicating the choreography of martial arts movies, from the rapid exchange of blows between combatants, to the use of improvised weapons such as pipes and bottles. However, the most notable aspect of Sifu's combat is its difficulty, which ramps up significantly across the first two levels. Your character can be killed in a handful of hits and, because you're constantly outnumbered and under assault, death is frequent.

Sifu mitigates the cost of death in certain ways. Each time you die, you can choose to restart the level or respawn at your current location. Choosing the latter, however, sees your character age by one year or several, which over time changes how they look and act. As your protagonist ages, they become physically stronger, but constitutionally more fragile, meaning they both deal and take greater damage. This continues until you hit 70, where the next knockdown will be your last.

It's a novel idea that neatly encapsulates the theme of your character's lifelong quest for vengeance. However, the main reason Sifu is hard is because it's a poor teacher. It throws you into the fight with only a minimal instruction of its mechanics, and introduces new enemy types and enemy attacks without explaining how they work.

In its school-of-hard-knocks approach, Sifu envisions itself as the tough but fair martial arts master, but comes across more as that one dude at your MMA class who uses martial arts as an excuse to bully people simply for being new to the art. It's one thing to lose because you made a mistake, but another because you have no clue what you're doing.

With better explication of its systems and a more graded difficulty curve, Sifu could be the melee combat game to beat. As it stands, though, it's simply too unreasonable in its demands for excellence.

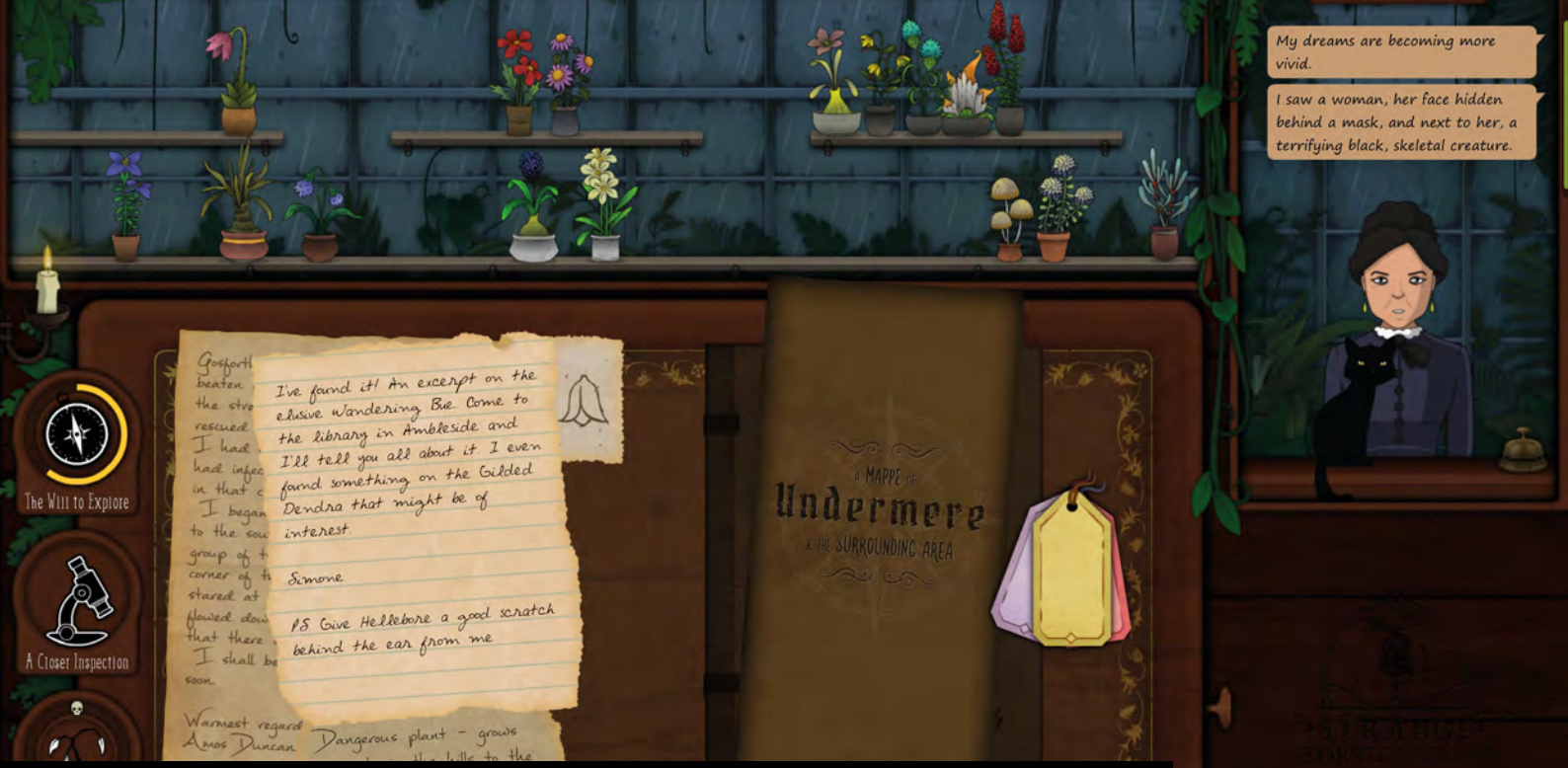
RICK LANE

/ VERDICT

A spectacular and engaging fighting game, provided you're willing to be rapped on the back of the hand with a spoon.

OVERALL SCORE

60%



STRANGE HORTICULTURE / £12.99 inc VAT

DEVELOPER Bad Viking / **PUBLISHER** Iceberg Interactive

Strange Horticulture puts you in charge of the Lake District's most successful plant shop, which might not sound interesting, but beneath the foliage of this cosy premise is a spooky, atmospheric and brilliantly devised mystery game about murder, witchcraft and the occult.

The game takes place over a series of days, with you serving customers who enter the shop at the ding of a bell. Most customers will ask for a specific plant, which you won't know about because you've overseen the place for all of five minutes. Fortunately, tools for plant identification are at your disposal, such as a microscope and floral encyclopaedia. Using these, you must figure out which plant on the shelf is the correct specimen, and give it to the customer.

Successfully identifying plants rewards you with more plants for your shop, and more descriptions of plants for your encyclopaedia. You'll also gradually accrue letters and notes detailing locations across the game's fictional twist on the Lake District. You can explore 'Undermere' by clicking on different map squares, acquiring further plants and pursuing the events of the story in the process.

In this way, Strange Horticulture provides you with a constant stream of gentle deduction puzzles. One customer might only know the local name of a plant, or smugly show off by giving you the Latin name. Others you might have to identify by colour, or by matching it with the encyclopaedia's (only partial) illustrations.

Customers also have their own little tales that, when combined, slowly unravel a broader story. For example, early in the game, a police detective arrives looking for a plant that will help keep him alert, revealing in the process that he's looking into a murder.

Not long after, you encounter a member of the local witches' coven, who through a different request, reveals the identity of the victim. During your business, you also get to make choices that affect the story's outcome in minor and major ways. For example, you can help a rude customer with his itchy skin condition, or deliberately give him a plant that will exacerbate it.

The game is simply but effectively presented, with lovingly drawn plants, well-written characters and a wonderfully eerie piano soundtrack, although the latter could do with being slightly longer. There are other minor flaws too. Your desk can quickly become cluttered with objects, so it's easy to accidentally close your map or encyclopaedia, which is slightly frustrating. The story also falls into some tired Lovecraftian tropes in its latter stages, rather undermining the central mystery.

Nonetheless, Strange Horticulture is unusual and imaginative – it's an excellent detective game with a powerful atmosphere and a decent, if not quite brilliant, story. Come for the plants, stay for the murder.

RICK LANE

MIGHTY OAK

+ Imaginative concept
+ Satisfying deduction puzzles
+ Compulsive storytelling

STUBBORN WEED

− Repetitive soundtrack
− Some inventory fiddliness
− Mystery falls flat towards the end

/ VERDICT

A weird game about selling weird plants to weird people, Strange Horticulture is a beautiful and fascinating specimen.

OVERALL SCORE

85%

REALITY CHECK

Rick Lane becomes a virtual assassin in Hitman VR, and casts a cynical eye on HTC's Viverse vision

OPINION

HTC VIVERSE

Following from Facebook's announcement of the Metaverse, HTC has revealed its VR future vision. Awkwardly termed the Viverse, it's HTC's attempt to create a commodifiable virtual space.

Accompanying the announcement was a three-minute video showcasing HTC's vision of an immersive Internet. Much of this replicates Meta's own concepts, with the central idea of linking VR, AR and 5G into a single, universally accessible ecosystem. Stylised user avatars work on virtual laptops in virtual cafés, attend virtual concerts and meet up in virtual social spaces such as museums. Then comes a deeply cursed segment in which the user 'purchases' a virtual bottle of wine (presumably an NFT) using bitcoin.

A cynical person might suspect the underlying motivation is to create virtual commodities and real estate for gullible investors to purchase, essentially creating money out of nothing more than a promise. The most interesting part of the video was a segment focused on exercising, because it showed an actor wearing VR goggles the shape and size of cycling sunglasses.

That's a vision of VR's future I can get behind, and it's a shame this notion of more accessible VR tech is now inextricably tied to technologies that are already notorious for scams and money laundering.

REVIEW

HITMAN TRILOGY VR / £49.99 inc VAT

DEVELOPER IO Interactive / **PUBLISHER** IO Interactive

After launching Hitman 3 with support for PSVR last year, developer IO Interactive has now extended VR support to the entire Hitman trilogy on PC. Now you can wander around iconic Hitman locations such as Sapienza and Miami, as well as all the levels from Hitman 3. It's a wonderful free addition to an already excellent game, although there are undoubtedly areas where IO Interactive could have pushed its VR adaptation further, both visually and mechanically.

On that first point, Hitman VR offers a substantial visual upgrade over the heavily compromised PSVR version. Distant objects are considerably more detailed, meaning PC VR gets much closer to replicating the epic sweep of Hitman's levels and skyboxes. The PC version can also properly render Hitman's impressive crowd scenes. Miami's racing spectators and Berlin's nightclub dance floor offer some of the most complex VR spaces ever witnessed through Fresnel lenses.

That said, the PC version still makes several cutbacks compared with the standard game. Hitman VR doesn't render reflections, for example, which ironically can make some scenes look flat. Moreover, the whole game has a slightly soft focus, lacking the visual acuity of its flatscreen equivalent. The result is a slightly inconsistent visual quality. In some areas, Hitman VR is one of the best-looking VR games around. In others, the shortcomings are very noticeable, and the graphics fall short of bespoke VR titles such as Half-Life Alyx.

The phrase 'slightly inconsistent' also applies to Hitman VR in play. The PC version offers a mechanical upgrade over PSVR, enabling hand tracking for both hands, rather than just your right hand. This means you can wield and fire weapons, punch people to knock them out, and throw objects at NPCs (although the game still uses a lock-on system to ensure thrown objects hit their target).

For environmental interactions, such as picking up objects, however, the game still employs more traditional button presses. This is mostly fine, but can become obstructive in certain situations, such as trying to pick up a weapon lying close to a body. The combination of classic Hitman controls with VR also produces some unusual idiosyncrasies.

For example, you can strangle NPCs with your free hands, but doing so often sends the game's collision detection into overdrive, with an NPC ragdoll flipping out as if it's being electrocuted. Also, when you use Hitman 3's camera, the game switches into a flatscreen view, which can be disorientating.

Frankly, Hitman VR isn't the optimal way to play IO's stealth trilogy. Setting aside the issues mentioned above, the limitations of your own body's reaction time makes sneaking considerably more difficult. Then again, playing Hitman in VR is a lot of fun, and it's absolutely worth experiencing IO Interactive's amazing level design in stereoscopic 3D.

This adaption might not go far enough to make Hitman a classic VR title, but as a free update to a game that was already superb, it's a fine addition to Agent 47's arsenal.

SILENT ASSASSIN

- + Big visual upgrade over PSVR
- + Hitman levels wonderful to explore in VR
- + Decent Touch controls

SILENT BUT DEADLY

- – Graphics fall short of non-VR version
- – Touch controls only partly implemented
- – Some interactive idiosyncrasies

VERDICT

Hitman's VR update is a lot of silly fun, although you won't want to play the whole game this way.

OVERALL SCORE

70%

NEWS

THE LAST CLOCKWINDER

Developed by a studio named Pontoco, The Last Clockwinder is a puzzle game that uses body movement tracking to create Rube Goldberg-style contraptions. On the game's Steam page, Pontoco describes the premise, saying: 'You are on a mission to repair an ancient tower built into the trunk of a colossal tree. Inside, you find a pair of gloves that allow you to turn anything you do into a looping clockwork automaton.'

In other words, the game can record and replay your body's movements. For example, you could record yourself picking fruit off a vine and then throwing it to another recorded clone, which then catches the fruit and passes it to another clone and so on, until the fruit reaches a canning machine. In this fashion, you create an elaborate chain of self-animated robots to solve the puzzle.

It's a genuinely novel use of VR tech, if also a slightly creepy reminder of how much detail about your body VR headsets are capable of retaining. On a sillier note, perhaps this is a case of being excessively British, but it's hard not to read 'Clockwinder' as an insult, particularly if you precede it with the word 'Absolute'.

In any case, The Last Clockwinder launches later this year. We'll have a full review when it drops. CPC

BUILD THIS WATER-COOLED PC

ANTONY LEATHER GIVES YOU A FOOLPROOF GUIDE TO BUILDING A STUNNING SYSTEM WITH HARD-TUBE WATER COOLING

Water cooling is practically mainstream these days thanks to all-in-one liquid coolers, but there are still some tricky obstacles to overcome if you want to build your own custom loop and build an effective, great-looking PC. What size radiator do you need to cool your hardware? How do you keep it quiet as well as cool? Will it fit in your case?

We'll be taking a look at all these aspects over the next few pages, as well as how to actually build a water-cooled PC, leak-test it, fill it with coolant, deal with rigid tubing and pick the best parts for your particular case. Our hand-picked components are guaranteed to work together, so you just need to select your own core components, add in our gear below and you'll be up and running.

WHAT RADIATORS DO YOU NEED?

Your choice of case can certainly dictate the size and number of radiators you use and in turn will dictate the level of hardware you can cool. On the flip side, if you've already picked your CPU and other components you want to water-cool, then you need to ensure you have enough radiator cooling capacity to cope and will need to pick your case accordingly.

For modern mid-range CPUs, such as a Core i5-12600K or Ryzen 5 5600X, a slim 240mm radiator will suffice if you want to keep noise down, and opting for a 45mm-thick radiator and good quality fans with high static pressure will offer enough cooling capacity to keep the fans at low speeds except for extreme scenarios. You can easily cool a monstrous Core i9-12900K or Ryzen 9 5950X with the same setups, but the fans will need to spin up more often.

We're using a 360mm radiator, as it will mean our Core i9-12900K is kept cool, and that there's enough cooling capacity to prevent the fans spinning up even after a few minutes of extreme loads. In addition, you could add a mid-range graphics card such as an RTX 3070 to this loop at a later date.

As most games require modest amounts of CPU cores and processing time, it's unlikely you'll see high loads on the CPU and GPU at the same time. However, a 360mm radiator is a minimum requirement for that kind of setup. In general, aim to have 240mm of radiator capacity to cool each major component in order to balance noise and cooling.

You don't need to stick to 120mm radiator variations, though, as there are plenty of other options. Radiator sizes based on 140mm fans can offer a better use of space in some situations, such as a 280mm radiator in a dual-fan mount. The latter has better cooling capacity than a 240mm radiator, thanks to a larger surface area, and it fits into spaces that can't always hold a 360mm radiator.

A 280mm radiator is an alternative option for our build this month, as the Fractal Design Torrent case has 140mm fans in the base as standard. Similarly, 180mm radiator sizes could be installed in the front, such as a massive 360mm radiator with two 180mm fans.

Just in case you're not up on your lingo, all the components in your water-cooling system – the radiator, distro plate, waterblock and pump/reservoir unit – need to be connected together in series, with the last component being connected to the first component in a loop – this is what we mean when we refer to a 'loop'. Your water-cooling components' ports will also usually be labelled with 'in' and 'out' to show the direction of travel.

TYPES OF RIGID TUBING

Clear rigid tubing comes in two flavours – PETG and acrylic. The former has a lower melting point than acrylic and, as a result, is practically shatter-proof at room temperature and is very easy to bend.

The downside is that it can become soft in a water-cooling loop if coolant temperatures get too high, which can happen if your pump fails, your radiator fans stop working or if you haven't set the fan control properly.

Aim to have 240mm of radiator capacity to cool each major component in order to balance noise and cooling

This can cause leaks as the fitting loses grip on the tubing, so it's vital to have safeguards. Meanwhile, acrylic tubing tends to shatter under pressure and requires more heat to bend, but its higher melting temperature means it won't lose its shape.

There's also brass tubing, which is usually coated in a variety of colours. It's not possible to bend this tubing yourself – instead, it comes in straight lengths or pre-bent sections that are coated after the bending process. As a result, you'll need to stick to single bends or opt for angled fittings to add bends to your tubing runs.

OUR HARDWARE PICKS

This month we're focusing on how to use some of the latest water-cooling hardware and combine it with Fractal Design's fabulous new Torrent case. As getting specific graphics cards is still a lottery right now, we've just focused on water-cooling a Core i9-12900K using a 360mm radiator, but we will offer advice on how to pick the right waterblock for your graphics card and how to go about fitting it.

CPU

- Intel Core i9-12900K

While the Core i5-12600K and Core i7-12700K have more than enough grunt for most people, the added cores and threads as well as slightly higher boost frequencies mean the Core i9-12900K is a beast in every task. It needs decent cooling to tame it with low noise levels, and this is where our water-cooling system can help. You can choose whichever 12th-gen Alder Lake CPU you like for this setup though.

MOTHERBOARD

- MSI MAG Z690 Tomahawk

The MSI MAG Z690 Tomahawk is one of our favourite Z690 motherboards. It's reasonably priced compared with the competition, and it supports DDR4 memory, which is currently a more compelling option than DDR5, which is expensive and currently offers little benefit. This affordable board has all you need to handle a Core i9-12900K.

CASE

- Fractal Design Torrent

Fractal Design's new ATX case – the Torrent – is easily one of the best-looking cases we've reviewed in the last few years. It might

not quite deliver on the features found in previous models, such as a removable roof section, but that's partly down to its design, with the PSU mount in the roof making way for monstrous airflow in the chamber below.

The massive interior makes it easy to work with the Torrent, and it has plenty of space for an extensive water-cooling system. We'll also be tweaking the airflow arrangement to suit our hardware.

STORAGE

- WD Blue SN750

You can use any M.2 NVMe SSD you like in this system, of course, but we've picked a WD Blue SN570 in our example, which offers fast speeds of up to 3,500MB/sec in a very reasonably priced package. We've opted for the 1TB model, which costs £90. If you have the budget, though, you may as well go for a PCI-E 4 drive such as WD's Black SN850.

GRAPHICS CARD

- Palit GeForce RTX 3070

Although the supply of graphics cards is steadily improving, the stock situation is constantly changing for different models, so it's a case of getting the best GPU you can afford, while keeping an eye on prices. We've added a bit of RGB lighting to the mix with a Palit RTX 3070 Ti card, which we found in stock for under £770, but we're not water-cooling it, so you can add your choice of graphics card to this system.

POWER SUPPLY

- be quiet! Strait Power 11 850W

Water-cooling gear doesn't add much to the power consumption of your PC, but it's worth picking a PSU that has support for custom cables, so you can don some individually braided and colour-matched cables to match your water-cooling lop. We've picked a be quiet! Strait Power 11 850W and paired it with some CableMod white braided cables.

CPU WATERBLOCK

- EKWB Quantum Velocity 2

EK's latest waterblock is absolutely stunning, with great RGB lighting and an easy installation process. The Quantum Velocity 2 features a simple backplate with integrated screws, which makes it blissfully easy to install. It's available for a range of sockets, and thankfully, EK ensured it was available from the outset with LGA1700 support, so you don't need to worry about compatibility with Intel's new CPU socket either. It costs a tad over £100, but it's absolutely worth the price.

RADIATOR AND FANS

- EK CoolStream SE 360 radiator
- 3 x Fractal Design Prisma AL-12 fans

We had several options when it comes to radiators. We could have opted for large 180mm or 360mm radiators to kit out the front of the case, a 280mm radiator in the base using the included 140mm fans, or a compromise of a 360mm radiator. In the end, we opted for the latter in the form of an EK CoolStream SE 360, which costs £68, along with a pack of three Fractal Design Prisma AL-12 fans, which will set you back around £40.

TUBING, FITTINGS AND DISTRO PLATE

- Corsair Hydro X Series XT Hardline 14mm tubing
- 10 x EK Quantum Torque fittings
- Corsair Hydro X Drain Valve
- Phanteks Glacier D140 distro plate
- 3 x 90-degree offset EQ Quantum Torque rotary fittings
- 14mm offset EQ Quantum Torque rotary fitting
- 3mm offset EQ Quantum Torque rotary fitting

We've opted for 14mm rigid acrylic tubing for this build, as its slightly extra width means it matches our hefty case a little better than narrower tubing. We've picked Corsair Hydro X Series XT Hardline 14mm tubing as it comes in 1m lengths, which we'll need for a run of tubing in our large case. For the tube fittings, we've used ten EK Quantum Torque fittings for rigid tubing and three 90-degree rotary adaptors for use on the pump.

We've also used 3mm and 14mm offset rotary adaptors, which help to align tube runs to keep them straight – these both sit on the distro plate. The latter is a Phanteks Glacier D140, which is a universal distro plate that sits in the rear fan mount of most cases and isn't specific to the Fractal Design Torrent. A distro plate looks great and can help to reduce the complexity of tube runs. Finally, we've used a Corsair Hydro X Drain Valve to provide a way to drain the coolant in future – we've installed this in the lowest distro plate port.

RESERVOIR AND PUMP

- EK Quantum Kinetic D5 PWM

It's always a good idea to get a combined pump and reservoir combo, in order to save space. We've opted for an EK Quantum Kinetic D5 PWM, which allows PWM control of the pump, and also has a flexible mounting kit and offers an easy way to fill the loop. We'll be fitting it to the front 120mm fan on top of the radiator.

DOES COMPONENT ORDER MATTER?

A popular misconception with water cooling is that it's better to position your waterblock after your radiator in the loop, as the coolant there will be cooler than at other parts of the loop. This is incorrect. Due to the extremely high flow rates in modern water-cooling systems, very little heat energy is actually transferred to the coolant as it passes through the waterblock. The temperature delta of coolant entering the waterblock and exiting it is actually very small.

Imagine a bus driving around a racing track and picking up people each time it got to a certain point, then dropping them off at another. It could drive more slowly and spend more time at the bus stop, or travel faster, but pick fewer people up each time. The end result is that the same number of people are transported between the two stops.

In a water-cooling loop, this means the coolant temperature actually remains fairly constant around the whole loop, and will be more so with higher flow rates. This means that component order doesn't matter, so you can route your tubing in the neatest and easiest way possible.

COOLANT

- Liquid.cool CFX Pure Blue

We've used Liquid.cool CFX pure blue coolant to fill our loop, but you can choose your own colour. You'll only need a one-litre bottle as we had plenty left over.

OTHER BITS AND PIECES

- Deionised water for flushing components
- Fine-tooth hacksaw for cutting tubing
- Heat gun for bending tubing
- Alphacool tube-bending kit
- Fill bottle for filling loop
- EK Leak Tester

Not all of these components are essential for building this PC, but most of them will make your life easier here, particularly if you've never built a water-cooled PC with rigid tubing before. It's best to make sure you're well equipped.

BUILDING THE PC

INSTALL CPU

Start by installing the CPU in the motherboard and applying thermal paste in a cross pattern, as shown 1.

FIT THE CPU WATERBLOCK

The waterblock secures using screws integrated into a backplate. It's extremely heavy, so place the waterblock onto the CPU and use one hand to hold it in place, aligning the screws with the socket mounting holes. Then turn the motherboard and waterblock over, and support the waterblock from underneath, allowing you to secure the backplate with it facing up 2. The waterblock is too heavy to reliably fit it any other way. Once it's secured, you can then turn the motherboard over again 3.

FIT HARDWARE INTO CASE

Next install the motherboard in the case as well as the SSD, memory and graphics card 4, so you can work out your tubing runs. We're assuming you know the basics of PC building here, so won't be going into all the detail, but for reference, there's a guide to building an Alder Lake PC in Issue 224 (**custompc.co.uk/224**).

FLUSH THE RADIATOR

Before fitting the radiator, we need to flush it to make sure all the residue and particles from manufacturing and shipping are removed. Use deionised water or coolant to do this job. Fill the radiator halfway using your fill bottle 5, then give it a good shake from end to end before draining and discarding the liquid.

REMOVE CASE FANS

We don't need the lower 140mm fans in the case, so we've removed them, which is easily done by removing the lower fan bracket 6.

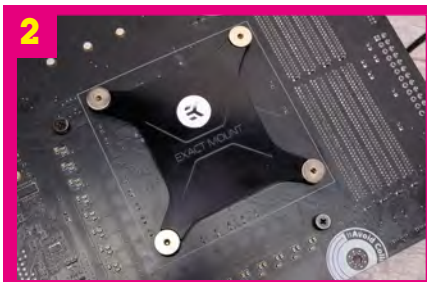
INSTALL FANS, RADIATOR AND RESERVOIR

We're using the new fans to push air through the radiator and out of the base, mainly because the distro plate that sits in the rear of the case is going to block the majority of ventilation holes that usually allow the case to make use of positive air pressure. The Torrent's two front 180mm fans are huge and powerful, so there's plenty of airflow to deal with this configuration.

Mount the radiator to the bracket first, with the threaded ports sitting at the front of the case. Then install the fans so that their cables face the motherboard tray, as this will make for easier cable tidying.

The pump we're using includes an adaptor to mount it to a 120mm fan mount, so we've placed it on the forwardmost fan on the radiator. This allows the reservoir to clear the graphics card and front fans, while still being easily accessible.

We've combined two angled rotary fittings together in one of the pump's ports, in order to point the tubing in the right direction across to the distro plate. Meanwhile, the other port on the pump has a third rotary fitting to point the tubing down to one of the radiator's ports 7.



FIT DISTRO PLATE

The distro plate uses existing fan mount screw holes to secure to the case, so fit it as shown 8. It will be pot luck as to whether any other ports in your chosen case line up with the ports on the plate, but usually some are close enough to work with, or will be usable with rotary offset fittings. We'll show how to use the latter in our Fractal Torrent case later.

WORK OUT TUBING ROUTES

There are numerous aspects to consider when working out the best tubing routes. Firstly, you need all your hardware fitted in the case in order to best assess these routes. You also need to avoid, where possible, crossing hardware. For instance, you don't want to block your graphics card or motherboard, as it will make getting at them a lot harder if you need to reset the CMOS, replace memory modules or install M.2 SSDs.

Have a good look at the routes needed to go to and from each component to make a clean loop with minimal bends. You want to limit the number of bends, especially double bends as these can take several attempts to get right, potentially increasing your tubing bill (and your frustration). Occasionally, you'll get lucky and find the ports on two components line up perfectly, like here with our build's CPU waterblock and one of the ports on the distro plate 9.

Once your hardware is installed, you'll be able to identify any straight runs too. For example, we found that the distro plate's second lowest port lined up perfectly once there were a couple of rotary adaptors on our pump, as well as the second port on the pump and a port on the radiator beneath it 10. The end result of using this tubing run is a PC that can have an air-cooled graphics card, memory or M.2 SSD swapped out without having to drain the coolant.

TIPS FOR DEALING WITH RIGID TUBING

While there are tools dedicated to bending tubing, and countless photos of PCs on social media that feature elaborate bends, bending tubing isn't essential. You can use angled fittings and joints to remove the need to actually bend the tubing, having several lengths of tubing joined by fittings instead 11. Using the correct thickness of rigid tubing is important too. Aesthetically, using thin tubing in a large PC makes it look a little spindly, while using thick tubing in a mini-ITX PC also looks odd.

If two components don't line up, whether you're attempting to run a straight or angled length of tube from one to another, an easy way to prevent a few millimetres from ruining your day is to use a rotary offset fitting. This has a rotating female port that sits away from the threaded port beneath it, offsetting the position of the fitting screwed into it 12. They're available with several different offsets depending on your requirements and they look fairly unobtrusive.

ADDING A GRAPHICS CARD TO THE LOOP

Your graphics card can often be one of the noisiest components in your PC, especially in games, so it's a great candidate for water cooling. You can check whether your model has a compatible waterblock available using compatibility checkers at websites such as **ekwb.com**, **corsair.com** and **alphacool.com**

Once you've chosen a waterblock, it's important to realise that fitting it will likely void your graphics card's warranty. You'll need to remove the graphics card's cooler and stock thermal pads and paste, apply new pads and paste and then fit the waterblock. The benefits in operating temperatures and noise reduction can be significant, plus you can also then mount your graphics card vertically, even right next to a glass panel, without having to worry about starving the fans of airflow.

Similarly, fitting extensions can help to boost a fitting's vertical alignment by sitting between the fitting and the water-cooling component 13. This can be useful to prevent a fitting fouling another component, or shift the fitting, so it lines up with a port on another component, perhaps allowing for a level run of tubing instead of one that's just out of alignment.

The bending process requires a number of additional tools, but it's not essential to buy them. Pre-bent lengths of tubing can be purchased as well, leaving you with just the cutting process to handle yourself, although you'll likely spend more money if you do it this way, as there will be a lot more waste.

BENDING AND CUTTING RIGID TUBING

Your first job before you start here is to get an accurate feel for where the tubing sits inside the fittings 14. It will insert into a hole and be grasped by an O-ring inside, but will sit on a ledge inside the fitting.

It's important to work out the location of this ledge and, if possible, identify an external feature on the fitting or use a marker pen to indicate the location – you can then take the necessary measurements to cut the tube to the right length.

On the EK Torque fittings, this ledge lines up with the outer lip on the fitting within a millimetre or so, so you can use this lip to work out the precise length of tubing required. Start with straight runs, as these are easiest to accomplish. Simply line up the tubing with the two ports, or use a ruler to measure the difference between the two outer lips, and cut the tubing to length.

There are a few ways to cut the acrylic tubing we're using. You can use a fine-tooth hacksaw, which is a common household tool in a well-equipped shed or garage 15. It's a great way to achieve straight cuts. A less common tool is a pipe cutter. These are usually used for copper and brass piping but can also be used on acrylic if done correctly.

Using a pipe cutter is less messy than sawing, although it may require a few seconds of sanding. However, good ones cost upwards of £30, so if you already own a hacksaw, there's little point investing in one, especially if you'll just be building one PC for now.

Once you've cut the tubing to length, you need to use a tube reamer (found in Alphacool's tube bending kits, but also available separately). This scours the outside of the tubing, creating a bevelled edge that will slide more easily into the fitting. Use a decent amount of pressure and rotate the tubing in the outer-edge (scoring) side of the reamer 16.

Then do the same for the inside of the tubing, using the other end of the reamer. The pointed end scours the inside of the tube to clear any debris from cutting. Once you've cut and reamed the tubing, press it into the fittings and secure it with the locking rings at either end.

Next, it's the tricky part. Bending the tubing requires accurate measurements, patience and probably some trial and error too. However, a few simple tools and steps to fine-tune the measuring and cutting process are all that's needed to create those bends.

The easiest way to work out the tube lengths for a bend is to simply create a 90-degree bend in a length of tube, then cut each end to length. However, it pays to keep waste to a minimum and save time trimming off endless pieces.

Insert a length of tubing into one port, then lay a ruler across the tube with the end sitting on the lip of the fitting on the other port 17. This will tell you how long the tube needs to be from one end to the peak of the bend. Doing this for both ends will ensure the bend is in the right

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place, wasting minimal tubing. This method can also be repeated to add multiple bends to a length of tube, and will result in far crisper bends than doing it freehand.

The tightness of the bend and the area you need to heat depends on the method and tool you use to bend it. However, you can use some tools, such as the Alphacool bending tool (found in the company's bending kits) we're using here, to work out the length of this section, as the outer lip of the tube recess in the tool lines up with where the tubing will actually sit 18.

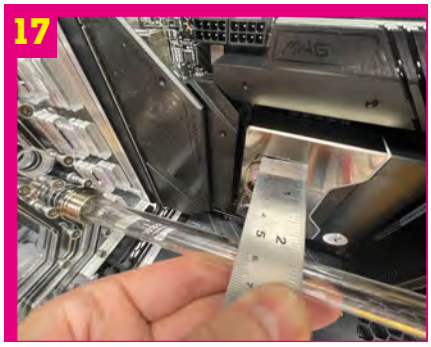
If you measured 10cm from the fitting to the outer edge of the tube, for example, line up this lip on the tool with the 10cm mark on the ruler and lay your tubing into the tool and at the end of the ruler. You can now see exactly where the tube will need to be bent in order to fold around the bending tool and mark the appropriate area that needs to be heated.

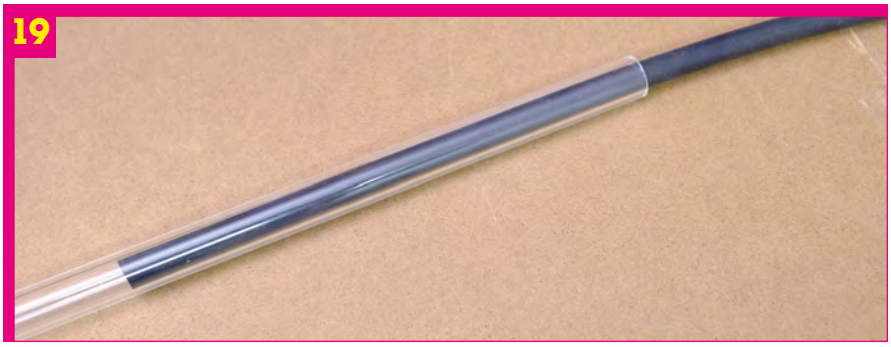
Once you've done that, add a spoonful of washing-up liquid to a glass and add three spoonfuls of water to create a soapy solution. Pour this into the tube then place a tube insert inside it 19. The insert will prevent the tubing from kinking when you bend it and is essential – again, this is a part of Alphacool's tube bending kit. The soapy solution will lubricate the insert and make it easier to remove afterwards. Don't use plain water, as this can boil and damage the surface of the acrylic.

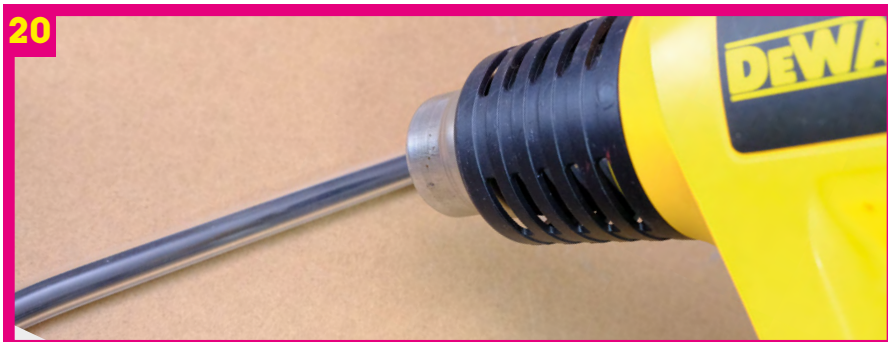
Use a heat gun to heat the acrylic, making sure you only heat the area you marked as requiring to be bent 20. If you heat outside this area, you can case the straight lengths to lose their shape too. Put the gun on a high setting and move it back and forth over the area quickly, while rotating the tubing with one hand at least once a second. Applying the heat evenly and rapidly is your goal.

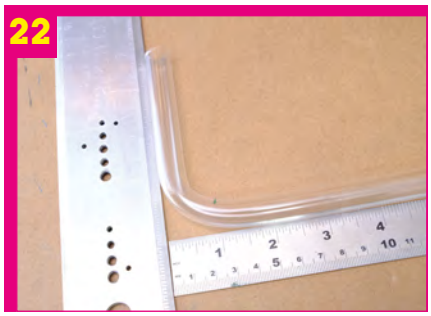
Eventually the acrylic will become malleable, but it needs to be loose, floppy and bend without resistance. Once that's the case, place it quickly onto the bending tool and wrap it around the 90-degree bend section 21. Don't press the tubing from the outside edge, as it will be soft and you could mark it. Once it's in place and looks right, you can blow on it to speed up the cooling process. After 20 seconds, it should be cool enough to handle.

Inspect the bend using an angled object, or lay two rulers end to edge against each other









and place the tube bend against them 22. You can then check that the tube lengths are correct to fit between the two ports your measured up earlier. If the tube is a bit too long, you can cut it to size with a hacksaw to get a clean cut – make sure it's millimetre-perfect.

Once you're satisfied, remove the tube insert and install the tubing 23. You often need to apply a good deal of force to acrylic tubing in order to get it to slide into the fitting – twisting it can help too. Just make sure you feel it slide in and if in doubt, pull out the tube and see how far it was inserted.

WHERE TO RUN THE TUBING

Starting with the pump, we've connected its left inlet port straight to the radiator using a 9.1cm length of tubing, a 90-degree rotary adaptor and tube fitting to point the tubing downwards. Another easy straight run goes from the pump's outlet port to the distro plate at the rear of the case 24. The coolant runs through this channel before exiting to the CPU waterblock further up with a 90-degree run of tubing 25. It then flows out of the waterblock and back into the distro plate to its second coolant channel before finally exiting again right at the top.

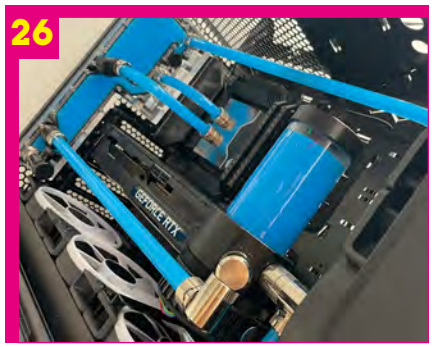
We've coupled two 90-degree rotary adaptors together on the pump's outlet to point the tube in the right direction, with a 34.8mm section of tubing. We also used a 3mm rotary offset fitting to align the tube fitting on the distro plate with the fitting on the pump outlet, as it was otherwise slightly misaligned and caused the tube to drop downwards.

Next, we had to deal with three 90-degree bent tube runs to, but these only required the use of standard tube fittings and no adaptors. These include two running from the CPU waterblock to the distro plate, and one from the top distro plate port back to the front of the case to meet the other port on the radiator 26. The latter was a very long run, with the horizontal section being 41cm from the tube end to the end of the curve, while the vertical section running down to the radiator measured 30.2cm end to end.

The lower 90-degree tube between the distro plate and CPU waterblock had one side that measures 12.7cm end to end, while the other was 8.3cm long 27. To make the tube sit level, we also had to use a 14mm rotary offset adaptor for this tube. The upper 90-degree tube between the two components was shorter, but thankfully didn't need an offset fitting, as the ports lined up perfectly. The lengths here were 10.2mm and 6.3mm for the edge-to-edge measurements.

LEAK TESTING AND DRAINING

Filling your loop is easy, but draining it to replace the coolant or remove it to upgrade a component can be a nightmare if you don't have a drain port. This is essentially a valve that can be connected to a vacant port and opened to allow coolant to flow out. At the very least, it allows some coolant to be drained in a mess-free and controlled way, but placing it in the

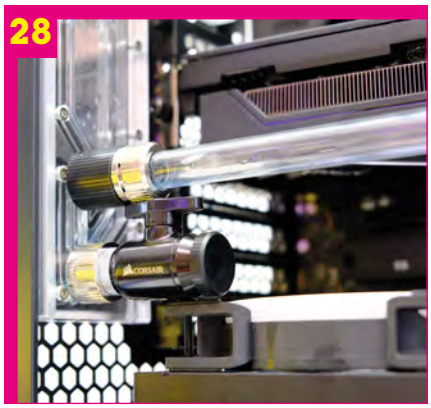


right spot can actually enable you to drain the majority of your coolant, especially if you're able to open a reservoir and blow to push more coolant around the loop to the drain valve.

In our particular loop, we've placed the drain valve on the lowest port on the distro plate 28. This distro plate has a large body of coolant above it, as well as the coolant in the reservoir, all of which will flow out once the valve is opened. You can attach a fitting for flexible tubing here, plus a temporary short length of flexible hose, enabling you to direct the outflowing coolant into a container.

Leak testing is essential, as there are so mainly potential failure points. Thankfully, there's a fantastic tool for the job that can uncover any one of these potential disasters before you even fill the loop with coolant. The EK Leak Tester tool adds pressure to the loop using a mini pump, and a pressure gauge allows you to see if the pressure drops, indicating a potential leak 29.

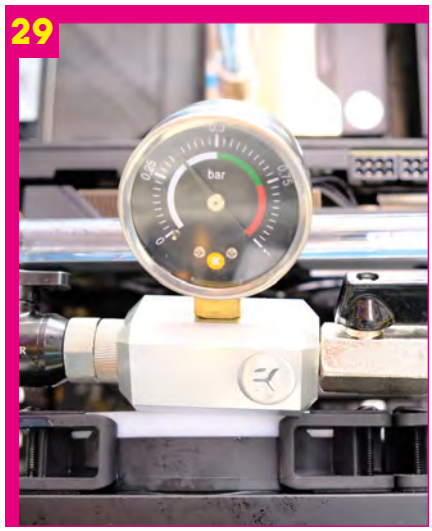
If this happens, don't be alarmed, as it can happen a lot and is often down to a slightly loose fitting – it may not even translate into a coolant leak. However, you should aim to see that pressure gauge stick for at least five minutes, with the pressure for a whole loop needing to be 0.3 bar. If you do spot a pressure drop, go around all the fittings and tighten them. The drain valve will come in handy here too, as it makes a perfect vacant port to attach the leak tester.



FILLING THE LOOP

With your leak testing done, grab your coolant and a funnel (or a fill bottle), then open the reservoir fill cap. Fill the reservoir to the brim 30. It's important not to let the pump run dry as it can result in internal damage. As we've already leak-tested the loop, there isn't any need to power the pump using the older method of using an ATX jumper on the PSU, so connect the power supply to your components if you haven't done so already and power on the PC.

Filling using a funnel will generally happen fast enough to fill the whole loop in one go. Just keep on topping up the reservoir with the pump



on full speed, but leave one or two centimetres of air in the top. This will allow the coolant to warm and expand, reducing the pressure on the inside of the loop, as air compresses more easily than the coolant. After this, you're ready to roll 31. Inspect the coolant level after a few hours, as air can become trapped in the reservoir having been bled from the loop – at this point you may need to add a dash more coolant. CPC

GAME OPTIMISATION GUIDE

Unsure of how to best optimise your in-game settings for the best balance of performance and image quality? **Edward Chester** and **Ben Hardwidge** crunch the numbers

Dropping from native resolution (left) results in a steady loss of detail

Whether you're trying to eke out a few extra frames per second to make a game playable on your aging hardware, or you're looking to get blistering frame rates in the latest competitive games, knowing which in-game graphics settings and other software tweaks to perform can be more than a little bit confusing. That's where this guide is here to help, as we assess the impact of a multitude of settings on a variety of games.

We've tweaked basic settings such as resolution, along with changes to character models, texture settings and everything in between. Not all games include a wide range of graphical settings while many include many more than we've tested here. However, by the end of this feature you'll be able to quickly zone in on the best settings to tweak for your needs.

TEST SETUP

Our testing was done with Assassin's Creed Valhalla, Cyberpunk 2077 and Metro Exodus, plus the new addition of Total War: Warhammer III. Perfectly demonstrating the huge variance in graphical settings that can be available within games, even our test games exhibited a wide range, with many settings not available or varying wildly in the exact changes they made. However, our results generally showed strong trends across the board, allowing us to make broad judgements that should apply to most games.

For our test hardware, we used just an AMD Radeon RX 6700 XT GPU for most of our tests, with a few results for Nvidia-specific features run on a GeForce RTX 3070. The rest of our test platform consists of an AMD Ryzen 9 5900X, 16GB of Corsair 3600MHz DDR4 RAM, an Asus ROG Strix B550-E Gaming motherboard and an AOC U28G2XU gaming monitor.

RESOLUTION REVELATIONS

It should come as no surprise that the single most impactful setting for gaming performance is resolution. Whether you're running a modest 1080p (1,920 x 1,080) screen or a huge 4K (3,840 x 2,160) panel, dropping the resolution of your game from the native resolution of your screen to a lower one will almost always bring the biggest increase in performance.

Performance leapt by an average of 85 per cent as we moved from 4K down to 2,560 x 1,440

A quick run through our game tests proves this point with performance leaping by an average of 85 per cent as we move from 4K down to 2,560 x 1,440, and jumping a further 37 per cent moving from this resolution to 1080p. Those sorts of gains will be almost universal, regardless of which game or graphic cards you're running, as there's an intrinsic link between the number of pixels and how much work a card has to do. It also makes you wonder why there isn't a more popular resolution for monitors that sits between 2,560 x 1,440 and 4K, but we digress.

There are several key downsides to changing resolution, however. The first is that modern LCD and OLED screens don't look very good when running at lower than their native resolution – unlike old CRT screens. The stretched image can look decidedly soft and lacking in sharpness, even if you just drop the resolution a little bit.

One way around this is to lower your resolution to one that divides evenly by four into your native resolution (for example, 3,840 x 2,160 is four times 1,920 x 1,080) and enable integer scaling in your graphics card driver (supported by both Nvidia and AMD's current GPUs). However, that's no good if you want to drop from 4K to 2,560 x 1,440, for example.

The second key downside is that if you lower the resolution of a whole game, you not only reduce the detail of the 3D portion of the game (which is the part that takes all the graphics processing power), but the 2D HUD portions too, resulting in overly large or low-detail HUD elements, such as the map, health bar and menus.

The final problem is that the number of options available for changing resolution in a game are often limited. For instance, if you

Basic resolution scaling (left) results in a noticeable drop in clarity compared with native resolution (right)

have a 3,440 x 1,440 ultrawide monitor, you'll find most games don't offer a lower resolution that fits the screen's 21:9 aspect ratio.

Instead, your only option is to drop to a squarer 16:9 aspect ratio resolution such as 2,560 x 1,440, and often monitors just stretch out this image to fill the screen, which looks terrible. Thankfully, there are at least partial solutions to all these problems.

CUSTOM RESOLUTIONS

The first place to start is solving the problem of not having enough resolution options. You can fix this by using the custom resolutions facility in your graphics driver. Simply open up Nvidia Control Panel, AMD Radeon Settings or Intel Graphics Command Center and seek out the resolution settings, where you should also find an option for creating a custom resolution.

It really is as simple as picking how many vertical and horizontal pixels you want and choosing the maximum refresh rate – any other settings you can leave at defaults. For instance, on a 3,440 x 1,440 screen, you could create a custom resolution of 2,580 x 1080 to get the exact same aspect ratio, or even 2,294 x 960 to lower the resolution even further. Or, if you're running a 4K screen you could try a resolution of 3,200 x 1,800.

Not all combinations will work, and sometimes even if Windows supports the resolution, a game might not play well with it, but there's generally a good chance you can find a setting that provides an ideal balance for your needs.

RESOLUTION SCALING

While custom resolutions can help you find an ideal balance of performance and image quality, they still can't help with the issue of oversized HUDs in games. Instead, that's where you'll want to use resolution scaling (or upscaling). This is where a game renders the 3D portion of the game at a lower resolution, but then applies all the 2D extras, such as the HUD, at a higher resolution that better fits with your screen.

Resolution scaling isn't generally presented as a specific alternative resolution but just a sliding percentage scale. So, if your game is scaled to 100 per cent, it's running at native resolution – as you drop the percentage, it runs at a lower and lower render resolution.

The big downside to resolution scaling is that it must be built into a game, and it's generally only an option that has appeared in the last few years. Thankfully, all our test games support resolution scaling and we see huge gains by dropping the render resolution.

Dropping to 90 per cent scaling, we saw an average increase in frame rate of 13 per cent while dropping to 75 per cent scaling on three of our games (Assassin's Creed Valhalla didn't support the same scaling options as the other games) saw a 32 per cent increase in frame rate, and dropping to 60 per cent saw frame rates rise by 56 per cent. However, the image really starts to look horrible at lower settings – we don't recommend going beyond 75 per cent, particularly if your native resolution is 1,920 x 1,080.

Those are some impressive gains here, though, and while you still get a noticeable softening of the image, the overall game experience is still surprisingly good thanks to the crisp HUD details.

That's particularly true for any games where fast motion is involved, as the softness is hidden in the motion blur anyway. For slower, more detailed games, such as Total War: Warhammer III, the loss in detail of small units is much more noticeable.

BETTER RESOLUTION SCALING – DLSS AND FSR

The key problem that can't be solved by resolution scaling or simply running at a lower overall resolution is the softness and loss of detail. That's where technologies such as Nvidia's Deep Learning Super Sampling

Enabling FSR (left) does soften the image but it's still very close to the full resolution version (right)

(DLSS) and AMD's FidelityFX Super Resolution (FSR) come in, as they use more sophisticated algorithms to enhance image quality of the upscaled game.

AMD FSR is the simplest technique, and it shares its approach with a number of other upscaling systems that have previously been implemented into several games. It uses an edge-detection algorithm on the final rendered image of each frame, then applies a sharpening and contrast-boosting filter on the image to better bring out details and reduce the softening effect of standard scaling – called bilinear scaling.

It's surprisingly effective – if you're starting with a reasonably high resolution and only dropping render resolution by a modest amount. However, it's again game-dependent (although it works on any graphics card), and it can't add back any details to enhance the upscaled image. Plus, it can still suffer significantly from visual artefacts if the game isn't running a quality anti-aliasing mode – more on this later.

A better solution can be found with Nvidia's DLSS, if you have a GeForce RTX GPU. Instead of simply applying some filters to each rendered frame of a game, it compares the new frame to previous frames and uses in-game movement vectors to help rebuild the lost details. Plus, it can even smooth out jagged lines and other visual artefacts that result from having no anti-aliasing. By and large, it works superbly well, in some cases actively improving image quality over native resolution in games that otherwise have poor anti-aliasing options.

The downside to DLSS, other than it being exclusive to Nvidia cards and needing to be built into the game, is that the across-time (temporal) comparison of images can result in some image quality problems if in-game movement is too fast. This makes it a poor choice for competitive first-person shooters, racing games and any other games where there's fast motion on screen. The fast movement can result in loss of detail and ghost images appearing.

We tested both DLSS and FSR in Cyberpunk 2077 – one of the only games available to include both options, and found both offered impressive performance gains and surprisingly good image quality, although DLSS was noticeably better. If your game has either of these modes, they're generally the best first option over fiddling with the resolution in any other way.

However, as we lowered the starting resolution to 1080p, both DLSS and FSR resulted in a quite poor experience, and this reflects our overall findings with making any changes to resolution. If you're starting with a relatively high-resolution screen (2,560 x 1,440 and over), and particularly if the pixel density of the screen is quite high, you can get away with resolution scaling, but at 1080p or below, image quality seriously suffers, so it's best to find more performance elsewhere.

Both FSR and DLSS offered impressive performance gains and surprisingly good image quality

RAY TRACING

Ray tracing is the elephant in the room when it comes to performance-impacting graphical settings. It's so well documented that it has a huge negative impact on performance as to be almost its defining feature. This is a fact that's all too obvious from our tests.

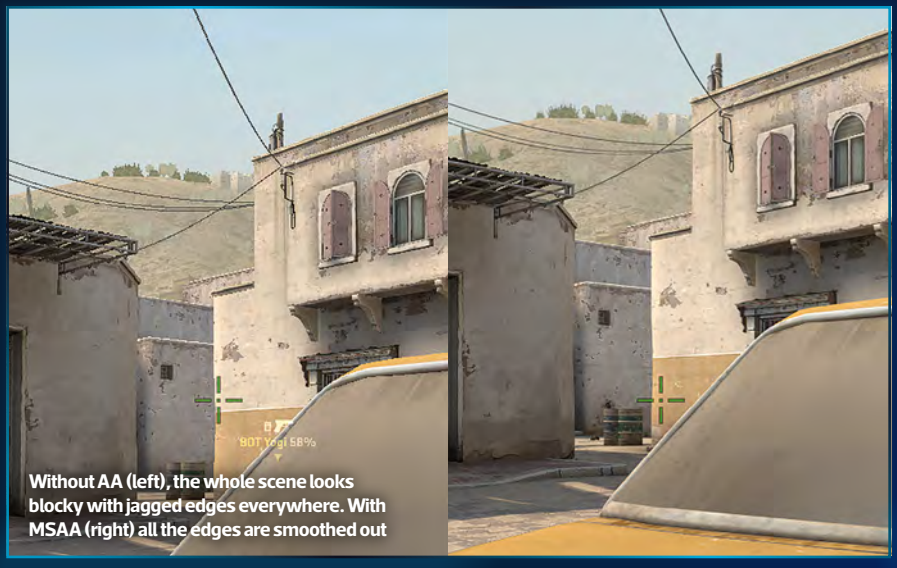
In Metro Exodus, our frame rate plummeted from 73fps to 38fps with Ultra ray tracing enabled. Meanwhile, in Cyberpunk 2077, performance drops from 48fps to 14fps with ray tracing set to its highest level. Granted, Nvidia 3000-series cards have greater ray-tracing capability than our RX 6700 XT test card, but those cards still take huge performance hits with ray tracing enabled.

What our more in-depth tests showed, though, is that there can be a surprisingly linear scaling of performance depending on the exact ray-tracing option you choose.

In Metro Exodus, you can have no ray tracing, High ray tracing or Ultra ray tracing resulting in respective frame rates of 73fps, 47fps and 38fps. Dropping back to the High setting would be an excellent compromise between performance and image quality in this instance.

Meanwhile, in Cyberpunk 2077, you get a wealth of ray-tracing options, including several options each for ray-traced shadows, ray traced reflections and ray-traced lighting. In terms of performance, we see a quite linear drop in frame rate as we enable more features, with the Ultra and Psycho presets causing the frame rate to plummet to 18fps and 14fps respectively, from a starting point of 48fps.

Thankfully, this game is a great example of how ray tracing can be fine-tuned to provide the most bang for buck. All the reflective buildings and rain-soaked streets mean that ray-traced reflections is the most noticeable feature visually, and while enabling this setting alone does hit performance hard (24fps), you're still saving a lot of performance compared with just turning up all the settings. Nonetheless, the overarching takeaway if you're really looking to get maximum performance from your system in most modern games is to turn off any ray tracing.



Without AA (left), the whole scene looks blocky with jagged edges everywhere. With MSAA (right) all the edges are smoothed out

ANTI-ALIASING

Anti-aliasing seeks to smooth out the visual artefacts that occur as a result of a game converting the 3D world in which it operates into the 2D grid of pixels that we see. To do this conversion, the game has to pick a colour for each pixel based on a single sample point within the area covered by the pixel. It's this disconnect between there being an area covered by a pixel, and only a single tiny point within that area being used to determine the colour of the whole pixel, that can create visual artefacts such as jagged edges to objects and flickering as the colour of a pixel flicks between two values from frame to frame.

Back in the day, the only two techniques for anti-aliasing were super-sampling and multi-sampling. These both worked on the same principle of calculating the pixel colour by combining the average of two or more sample points rather than just one. This greatly increased the likelihood that where you have strong differences in colour meeting at the edges of objects, the differences in colour would average out a bit and reduce jagged edges and flickering pixels.

The problem is that the extra sample points require the game to basically render the whole pixel again for each extra point, hugely impacting performance. Super-sampling samples every pixel of the final image twice or more, so kills performance, but multi-sampling uses edge-detection techniques to only double the sampling for the edges of objects.

Super-sampling anti-aliasing (SSAA) is largely unavailable these days, but some games running on older engines still have multi-sampling (MSAA) as an option, such as Counter-Strike: Global Offensive. If it's available, it offers an excellent balance of image quality and performance.

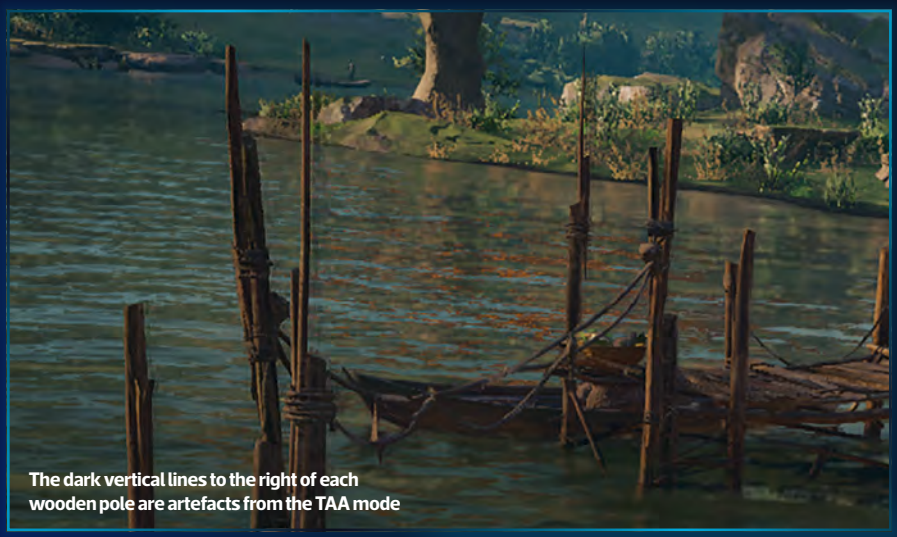
The even bigger problem with MSAA and SSAA, other than their performance impact, is that modern games now use many rendering techniques that take place after the point where traditional AA sampling would be done. This so-called differed rendering means there's simply no way to implement traditional AA, so we now have two commonplace alternative methods.

The first is to render the scene, then take that final jagged image and smooth out the edges using a 2D edge-detection algorithm.

The biggest downside to TAA techniques is that they don't cope well with fast motion, such as in FPS and racing games

This is how techniques such as FXAA and SMAA work. The results are generally quite poor, with a slightly blurry final image, and they also can't do anything about the flickering of pixels quickly changing colour between frames. The upside to these techniques is that they have essentially no impact on performance. Enabling FXAA in Total War: Warhammer III, for example, only dropped the frame rate from 54fps to 53fps.

The other modern AA technique is called temporal AA (TAA or TSAA), and as with DLSS, it uses information from previous frames to inform how the next frame should be rendered. These techniques can work well for fixing jagged edges and flickering pixels.



The dark vertical lines to the right of each wooden pole are artefacts from the TAA mode

What's more, they generally have a minimal performance impact. Enabling TAA in Total War: Warhammer III dropped our frame rate from 54fps to 49fps or 48fps, for the Normal and High modes respectively. Likewise, Cyberpunk 2077 simply has a form of TAA hardcoded into the game – there's not an option to run the game without it, unless you modify the config files – as it has so little impact on the game's performance.

The biggest downside to TAA techniques is that they don't cope well with fast motion, such as in FPS and racing games. With one flick of the mouse or steering wheel, you can be facing a completely different direction and the game has almost no meaningful information from the previous frame with which to smooth out the next frame. This can result in ghostly images from previous frames and a general loss of detail.

We can see this quite clearly in the Assassin's Creed Valhalla benchmark. As the camera sweeps past the dock, you can see ghost versions of the upright wooden poles used to construct the dock.

The upshot is that there are three main takeaways for AA in modern games. First, if SSAA or MSAA are options, disabling them will net you significant performance gains, although 2x MSAA is definitely worth turning on if you can get away with it. Second, if the game you're playing is an FPS or relies on fast motion for a competitive edge, disable any temporal AA options if they're available. You won't gain all that much performance, but you'll get a sharper (though jagged) image with no potential loss of detail.

Meanwhile, for any slower-paced games, most temporal AA modes work well and have minimal performance impact, so you can safely keep them turned on. Alternatively, if you're seeking better overall performance anyway, turn on DLSS if it's an option, as this adds the effect of temporal AA as well as upscaling.

TEXTURE FILTERING

Like anti-aliasing, texture filtering is a graphics option that dates back many years and aims to reduce the aliasing effects that result from, in

With bilinear filtering (left) distant textures become blurry but with anisotropic filtering (right), texture detail is retained

this case, mapping a 2D texture (used to paint the details onto in-game surfaces and models) onto the 3D surface of a model in a game. When viewed from an oblique angle, surfaces that use textures can appear rough and jagged, with distant textures breaking up into a jumbled mess of pixels. Texture filtering smooths out these jumbled pixels but, as with AA, there are several methods for doing this smoothing that can provide varying results.

The most basic option here is bilinear filtering, which simply takes an average of the values from the texture pixels (texels). It smooths out the blockiness but textures very quickly lose all detail, becoming a blurry mess. However, it has such low performance impact that nearly all games will include bilinear filtering by default.

Next is trilinear filtering, which improves on bilinear filtering by smoothing out the steps that can occur with bilinear filtering when you move from one level of texture detail to the next level.

The final option you'll find in most games is anisotropic filtering (AF). This essentially pre-stretches textures to better fit the angle of the surface to which it's being mapped, resulting in textures retaining detail even as they stretch off into the distance. AF can be applied at multiple different sample levels, from 2x up to 16x, with greater demands placed on your graphics hardware as you go up the scale.

What our testing has shown, though, is that while AF used to be a setting that you had to turn down to maintain performance, these days, it's not far off being a free option.

In the two games of our main test suite that included a texture filtering option, enabling 16x AF only dropped a single frame per second compared with 4x AF.

We also tested it in a more performance-orientated game – Apex Legends – and found that enabling 16x AF only dropped performance by an average of 5 per cent compared to bilinear filtering. Considering the significant improvement in clarity that 16x AF brings, it's absolutely a setting we'd leave turned up except as a last resort.

TEXTURE DETAIL

Texture detail is also a setting you'll find in many games. As its name suggests, it will tell the game to reduce the level of maximum texture detail it will apply to the models in the game.

The smaller textures reduce GPU memory usage and the demand on memory bandwidth, and can simplify some subsequent pixel-level effects.

However, as our test suite demonstrates, you won't see huge gains from turning down texture detail in a lot of games. In Cyberpunk 2077 and Total War: Warhammer III, we saw just one or two frames per second dropped on average, when moving from low detail to the highest settings, despite there being huge drops in image quality.

In Assassin's Creed Valhalla, we did see more of a performance difference, dropping from 78fps at the lowest setting to 74fps at the highest setting, but that's still only 4fps.

Considering the drop in image quality when opting for low-quality textures, we'd recommend only turning down these settings as a last resort, or if your graphics card is particularly old or low-end and therefore has a low memory capacity (under 6GB) and bandwidth.

Turning down texture detail (left) results in big drops in image quality but minimal performance gain, unless your card has very limited video memory

WORLD DETAIL

Many modern games will include an overarching world detail setting that can vary in its exact meaning from game to game, but generally controls how the game handles the detail on environmental objects, both in terms of the distance before some detail will be shown on screen, and the quantity of some of these environmental objects, such as clumps of grass on a hut roof.

In Assassin's Creed Valhalla, this setting made quite a difference to the amount of objects that would suddenly pop into view as you drew closer, and the overall number of objects on screen. As you dropped to Medium or Low world detail, there was a noticeable amount of objects popping into view, and a loss of extra elements throughout the scene.

In terms of performance, we saw frame rates drop from 82fps at Low world detail to 74fps at Ultra, with Medium delivering 80fps and High getting 77fps. That's a neat linear drop, so it's worth experimenting with this setting to see if you notice a visual difference between the very highest settings and, if not, it's worth turning this setting down a bit.

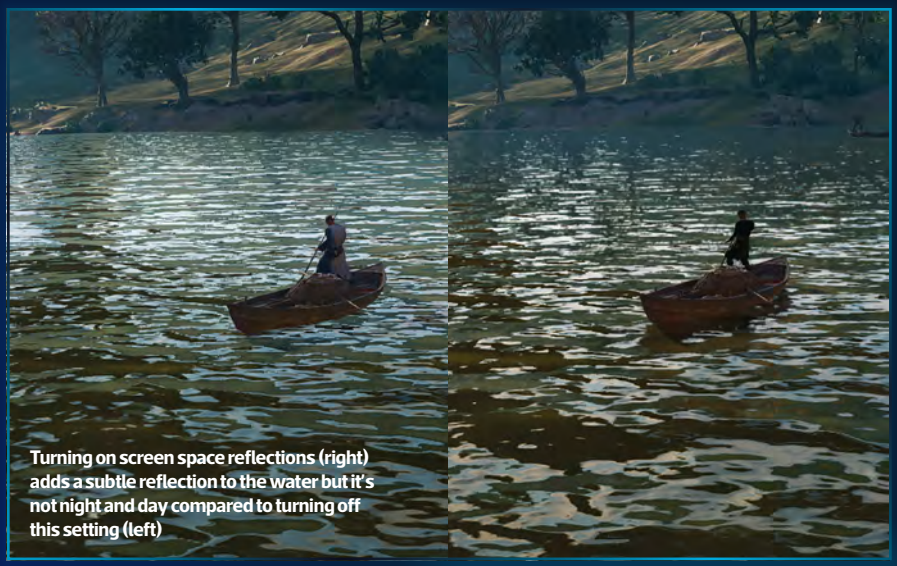
Dropping world detail to low results in the grass on these huts disappearing

OTHER DETAIL SETTINGS

In many games you'll find detail settings for specific aspects of a game's world, such as grass and other foliage, terrain, units, cloth simulation, hair and water. Depending on the game, some of these settings may have a large or small effect.

In our suite of games, we found a wide range of extra detail settings. For example, Assassin's Creed Valhalla provides settings for water quality as well as clutter level (the number of little extra items scattered around the game world) and the previously mentioned overall world detail. Total War: Warhammer III includes settings for unit detail, tree and grass detail, terrain detail, cloth simulation, unit size and VFX detail.

Given the presence of these settings in these games, it was no surprise they had some impact on performance. However, for the most part, the impact was minimal. In Assassin's Creed Valhalla, the water setting made almost no difference whatsoever, despite a modest drop in visual fidelity. Meanwhile, clutter saw a steady drop of 1fps per clutter detail level. As such, you should generally be fine leaving these settings on high and instead experiment with the world detail level to get a bigger performance impact overall.



Turning on screen space reflections (right) adds a subtle reflection to the water but it's not night and day compared to turning off this setting (left)

As for Total War: Warhammer III, the largest impact was from the VFX setting – used for effects such as smoke and fire – which saw performance jump from 48fps to 52fps when dropped to its lowest level. Next up was the tree and grass detail, which moved us from 48fps up to 51fps. The other settings made almost no difference to performance though – even dropping the size of the units (which has a dramatic effect on the sense of scale) hardly affected the frame rate.

In many ways, it's reassuring to know that while many games have a host of these object detail settings, and that fine-tuning all of them will get you the best balance of performance and image quality, a lot of the time you can leave them turned up at least to high settings and not lose much performance.

SHADOWS AND LIGHTING

Certain lighting, reflection and shadow settings can be among the most performance-challenging and visually obvious settings in many games. However, in our test games, we found they generally made a modest impact on performance, and to an extent the visuals too. Side by side, you could notice differences that add up to a richer, more realistic-looking environment, but you could certainly get away with turning down quite a few options.

Looking first at Cyberpunk 2077, here we get a great mass of lighting options – without even considering ray tracing – which can vary performance from as low as 48fps to as high as 66fps. However, you'll see from our screenshot that while there's definitely a flatter look with all these settings turned down – with fewer shadows from the roadside plants being the most obvious change – the

Even basic shadows (left) in Cyberpunk 2077 look decent, so you can turn them down to get faster performance

scene still looks good and the car's shadows and reflections still hold up. For the sake of that frame rate, these are all settings that are worth turning down.

With Assassin's Creed Valhalla, we saw a fairly linear increase in frame rate as we progressively disabled screen space reflections, which removes reflections of characters in reflective objects such as water, then moved from high shadow detail down to low shadow detail. In total, we went from 74fps up to 82fps. That's hardly a huge change but it all adds up. Nonetheless, with the visual impact generally being fairly subtle, you can certainly play around with these settings to gain a little more performance.

It was in Total War: Warhammer III that we saw the largest differences in performance, jumping from 42fps at Ultra settings, to 58fps with all the shadow and reflection settings turned down. The biggest jump came from turning off shadow detail completely, moving us from 52fps to 58fps. Otherwise, the various shadow detail settings made minimal performance difference, so were worth leaving turned up.

Across our test games, the shadow and lighting options that had the biggest impact on performance were screen space settings, such as screen space ambient occlusion (SSAO), screen space shadows and screen space reflections. For example, turning off SSAO in Total War: Warhammer III gave us an extra 4fps, and you get another extra 4fps if you don't enable screen space reflections. Likewise, in Cyberpunk 2077, dropping screen space reflections to medium increased the frame rate from 48fps to 55fps, and dropping it to low pushed it up to 57fps.

In Assassin's Creed Valhalla, the water setting made almost no difference to performance whatsoever

CONCLUSIONS

To a certain extent, the exact graphical settings that provide the best balance of image quality and performance will always come down to the specific game and whether high-speed, fine details, dazzling lighting or vast draw distances are a priority, but our tests have highlighted some key takeaways.

The first is that, by whatever means, dropping the number of pixels your system has to process nearly always brings the biggest boost in performance, whether that's via manual changes to resolution, in-game resolution scaling or using technology such as DLSS and FSR. The exception is if you're running a 1080p screen or lower, where the loss of detail is too great and you're better off trying to turn down other settings first.

The next obvious step is to turn off any ray-tracing features, as it destroys performance more than any other setting. Next is to make sure your anti-aliasing settings are optimised for the style of game you're playing. If it's a fast game, you'll want to turn off any temporal AA, especially if another AA option is available. Conversely, most TAA options work well with slower-paced games and have little impact on performance, so are worth leaving on.

When it comes to pretty much all the other shadow, lighting, detail and texture settings, the vast majority have modest impacts on performance individually, so you can get away with at least starting with these all turned up fairly high. Often the very highest setting will hit performance the hardest and have the least noticeable visual effect, so aiming for that second rung down is the best place to start. CPC

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
ZimaBoard 216

Billed as a 'single-board server', the ZimaBoard is an impressive beast

Despite being a computer built onto a single circuitboard, IceWhale's ZimaBoard doesn't bill itself as a single-board computer. Rather, it's called a 'single-board server' – and the company does a pretty good job of backing up that title with an impressive list of features.

All three ZimaBoard models share the same overall design – a large metal upper body that doubles as a passive heatsink, the board and then a three-layer acrylic protective base on the underside. The front of the board has two SATA 6Gbps ports with a single power connector, while the rear plays host to a pair of Gigabit Ethernet ports, two USB 3 ports and a mini-DisplayPort 1.2 output capable of providing a 4K display at 60Hz.

There are two full-speed SATA ports, but the bundled cable only has power for a single drive

The side of the ZimaBoard hosts a 4x PCI-E 2 slot, with its end cut to allow for longer boards. It's compatible with any PCI-E card that doesn't require additional power, with a caveat – you need to remove the expansion slot bracket, or it will scrape the metal upper and block the mini-DisplayPort connector. There's also no way to secure the card in place, making the port's inclusion more of a novelty, unless you transplant the ZimaBoard into a new case.

It's the internals that set the three models apart. The base model, the ZimaBoard 216, has 2GB of LPDDR4 RAM running at 1600MHz and 16GB of eMMC 5.1 storage. The top-end ZimaBoard 832 has 8GB of LPDDR4 RAM running at the same speed and 32GB of storage, while the mid-rate stretch-goal ZimaBoard 432 drops the RAM to 4GB but retains 32GB of storage.

There was another difference planned too. The ZimaBoard 216 was set to have a dual-core Intel Celeron N3350 CPU, while the other models enjoyed a quad-core Celeron N3450. This idea appears to have been scrapped, however, with the review sample ZimaBoard 216 arriving with a Celeron N3450 as a surprise upgrade.

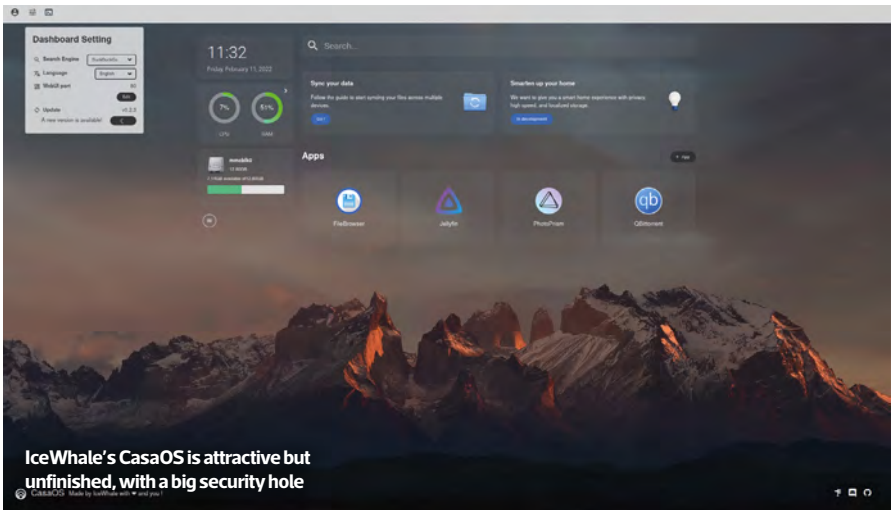
For anyone used to Arm or RISC-V-based single-board computers, the ZimaBoard's

NEWS IN BRIEF

Arducam updates bring Bullseye support

Arducam has released a series of updates to its software, which address the Raspberry Pi OS Bullseye compatibility issues noted in Issue 223's review of the company's 16MP Autofocus Camera Module.

The drivers and focus utility now work in both Buster and Bullseye, although manual updates will be required as and when new kernels are released. Arducam was also unable to offer any estimates of the lag time between kernel releases and driver development. Those who had struggled with the camera under Bullseye are advised to run the installation script again to pull down the latest software.



IceWhale's CasaOS is attractive but unfinished, with a big security hole

accessibility will come as a surprise. It's a fully functional 64-bit x86 computer, complete with an American Megatrends UEFI BIOS accessible on boot. Specifications allowing, it will run anything you can run on your desktop PC, including Windows 10, if that takes your fancy.

The board arrives running CasaOS, a customised Debian Linux onto which IceWhale has added a browser-based user interface and a selection of Docker containers handled through an 'app store'. The user interface is attractive, but at the time of review, only partly functional. New users are prompted to create a user account, but this only affects the CasaOS menu and not any of the Docker containers or underlying Debian OS. The smart home button is marked as coming soon, and the drive management feature is only partially functional.

There's a bigger problem too – CasaOS comes with a default username and password of 'casaos/casaos', and with SSH enabled. Nothing you do in the browser interface will change the underlying account or its password, giving anyone on your network complete control over the device – a major oversight.

Four applications are pre-installed – a file browser, the Jellyfin media manager, PhotoPrism and QBitorrent – with a small number of more applications, including Home Assistant, Nextcloud and Syncthing, available in the bundled app store. You can also drop into Debian and install applications manually, if you prefer.

Oddly, CasaOS makes no use of the mini-DisplayPort output. Connecting a display reveals a text console, although you can quickly install the desktop environment of your choice. There's also no way to use the CasaOS user interface locally, except by using a web browser in full-screen mode.

The very clearly unfinished CasaOS aside, the ZimaBoard impresses. The Intel Celeron at its heart delivers benchmark performance double that of similarly priced Arm-based competitors, while the on-board Intel HD Graphics 500 supports QuickSync for video transcoding and surprisingly speedy 3D acceleration.

Storage performance is great too. The eMMC storage on our sample hit 172MB/sec read and 56MB/sec write speeds in benchmarking, with a USB SSD managing 436MB/sec read and 399MB/sec write. The SATA ports, meanwhile, hit 533MB/sec read and 453MB/sec write in testing. However, the bundled cable supports only one drive, so you'll need to go shopping if you want to add a second one.

Meanwhile, the ZimaBoard 216 power draw shows an idle draw of 1.75W in headless mode and 3.35W with a display connected, rising to a hefty 13.5W under a full-load scenario – twice that of a Raspberry Pi 4 Model B 8GB. Those figures go up, of course, if you start taking advantage of the SATA, USB, or PCI-E connection options.

The ZimaBoard doesn't yet deliver on its promise thanks to CasaOS' shortcomings, but for anyone willing to roll their own software, it's a compact device with some impressive performance. All ZimaBoard models are available to order from **zimaboard.com** now, starting at $119.90 US (around £88 ex VAT) – $20 higher than planned – for the 216 as reviewed.

The PCI-E slot to the right is an interesting addition, but it's not that convenient to use

REVIEW

DytSpectrumOwl

The DytSpectrumOwl looks to offer FLIR-like thermal imaging capabilities at less than half the price

Thermal cameras are incredibly useful tools for a range of troubleshooting scenarios, from finding hotspots on a circuitboard when coming up with cooling systems, to spotting gaps in insulation without having to take apart your walls. Plus, if you're the Predator, they help in the hunt.

They're also expensive. The FLIR ETS320, reviewed back in Issue 201, is a prime example. Designed for circuit analysis, it offers a high 320 x 240 thermal resolution and a clever adjustable stand – and comes with an eyebrow-raising £3,119 (inc VAT) price tag, which puts it well out of reach of all but the most well-heeled hobbyists.

Dianyang Tech isn't as well known a name, at least in the West, but it's aiming to change that with the launch of the DytSpectrumOwl. The thermal camera itself, a chunky box-like design encased in thick metal, admittedly has a lower resolution than FLIR's offering. With a 260 x 200 thermal resolution, though, it's a lot sharper than the entry-level devices you can buy to connect to your smartphone, and offers an impressive functional range of 20mm to 2m.

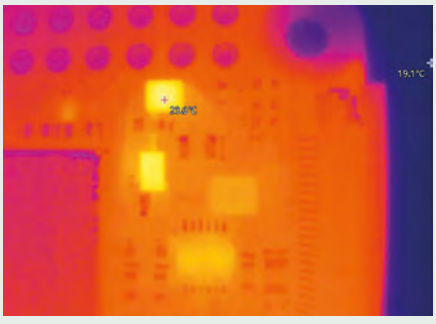
That latter feature reveals a key area where the DytSpectrumOwl actually surpasses the ETS320 – the thermal camera has a large adjustment knob for a manual-focus lens, allowing the user to quickly and easily adjust the focus point. The ETS320, on the other hand, has a very short 70mm fixed focus – you can only unofficially and awkwardly adjust it using a third-party 3D-printed tool (see Issue 206).

The camera module's focus knob is a fantastic feature, but a lens cap would have been a handy bonus

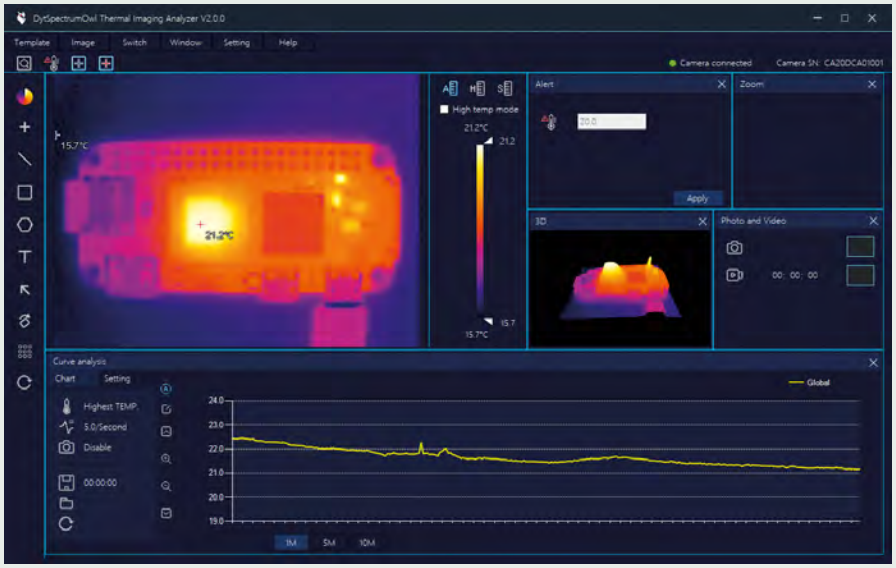
As with the ETS320, the DytSpectrumOwl comes with an adjustable stand. The sample on test uses Dianyang's earlier manual design, which is pleasingly adjustable and can be mounted on its rubberised base in portrait or landscape orientations. However, retail models will include a new motorised stand, which adjusts its height under computer control

There's not much in the way of physical controls on the DytSpectrumOwl. There's a single power button, which doubles as a power LED, and a USB Type-C port for connecting to a host device.

While the ETS320 has a battery and built-in display for cordless use, the DytSpectrumOwl will always be tethered – a companion Android app is in the works



Thermal images are exported without a scale, and there's no way to use the thermal data in third-party software



The bundled software packs some impressive features, but is Windows only

for mobile use, but it sadly wasn't ready for testing at the time of review.

Meanwhile, the main software, developed in-house at Dianyang Tech, is impressively fully featured – providing you're running Windows. Linux and macOS users are shut out, aside from the undocumented ability to use the thermal camera as a webcam. The software is designed to be modular, presenting a 'desktop' on which 'windows' can be arranged. There's a selection of predefined layouts already available, and you can customise and save your own.

The review sample included a robust adjustable stand, while retail models will get a shiny new motorised version

It's a great feature, because there's a lot to customise. The main window provides a view through the thermal camera, plus automatic and manual placement of up to 40 measurement points, shapes and continuous lines. It also offers alerts, a cursor-following zoom, adjustable thermal scales, buttons to capture still images or videos, and a curve-analysis chart.

This latter feature is particularly powerful – any measurement points added to the board are graphed in real time over one, five or ten minutes. Alerts can be set to capture images in the event of excessive heat, and the raw data can be logged to a comma separated values (CSV) file for later analysis.

There's also a '3D' view, which is eye-catching but of questionable utility. It takes the thermal image from the camera and deforms it into a side-on view, using the relative temperature of each measurement point to determine height.

The resulting image is full of peaks and valleys, but it doesn't make hot and cold spots any easier to see than the flat thermal image, plus it can even hide cold spots behind higher hot spots.

Not all the software's features are as slick. While thermal images are saved as what Dianyang calls 'radiometric JPEGs', they don't follow the generally accepted standard, making it impossible to extract the thermal data contained within them. The images are also enlarged compared with the actual thermal resolution, and they lack a scale for reference.

These are issues that could, and hopefully will, be addressed in future software updates, but for now make the DytSpectrumOwl hard to recommend as a direct competitor to any of FLIR's rival devices.

What makes the DytSpectrumOwl a tempting proposition is its price. Following a now closed crowdfunding campaign in which the camera and motorised base were sold for just $699 US (around £515 ex VAT), Dianyang Tech is selling the bundle for $1,359 (around £1,002 ex VAT).

That's not impulse-purchase cheap by any stretch of the imagination, but it does make the device's shortcomings compared with the considerably more expensive ETS320 easier to swallow. The DytSpectrumOwl is available to order from **dyt-ir.com** now.

NEWS IN BRIEF

DevTerm RISC-V SOM hits first-boot

Clockwork Pi has shown off a new drop-in system-on-module for the DevTerm (reviewed in Issue 222), which uses a free and open-source processor core based on the RISC-V instruction set architecture. 'This is a full-featured portable PC based on a 64-bit RISC-V open-source instruction set chip that's ready for the simple tasks of everyday life,' says company founder Hal Lui.

'In short, "freedom" has permeated every bit and every transistor.' The SoM is based on the same Allwinner D1 chip as the Nezha SBC (see Issue 221) and should deliver equivalent performance. No price had been announced at the time of writing.

REVIEW

Cyntech Raspberry Pi Heatsink

The Raspberry Pi 4 is a powerful device, and some form of cooling is recommended if you want to get the most out of it under sustained heavy workloads. The market is flooded with heatsinks and fans, from tiny stick-on accessories to impressively featured devices such as the Pimoroni Fan Shim (reviewed in Issue 194, alongside the Pimoroni Heatsink and 52Pi Ice Tower).

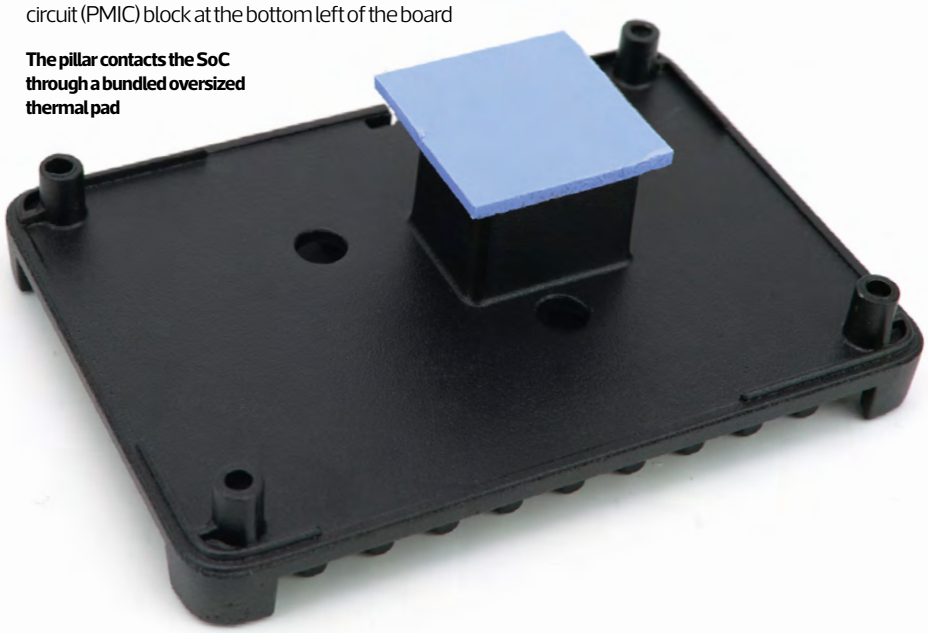
Cyntech's latest design sits closer to the 'stick-on accessory' end of the spectrum. It's a hefty heatsink that takes up just over the footprint of the Raspberry Pi 3 and 4 boards for which it's designed to cool entirely passively. Oddly, Cyntech has opted to tie the design into its family of two-part plastic cases. Rather than attaching to a Raspberry Pi board directly, the heatsink is designed to be sandwiched between the base and lid of the plastic Cyntech Case and held in place by the case's screws.

The heatsink is a solidly built lump of anodised aluminium, with a large pillar reaching down to contact the system-on-chip (SoC) of its host Raspberry Pi board. As is unfortunately common in Raspberry Pi heatsink designs, however, the pillar ignores the power management integrated circuit (PMIC) block at the bottom left of the board – the second-hottest part of the Raspberry Pi 4, after the SoC.

The two-part case has a surprisingly deep base, which accounts for the heatsink's tall pillar – originally intended to support HAT add-ons. Getting the board into the case involves inserting it at an angle to allow the USB and Ethernet ports to stick out at one side, and the HDMI, power and audio ports to stick out at another – you then push it home with a loud click as the 3.5mm jack pops into place. The process is a little tricky to figure out by trial and error, but there's a video guide to assist.

Four screws, which grip tightly into the plastic base, secure the board. Thermal transfer between the Raspberry Pi and heatsink is handled by a bundled thermal pad, cut considerably larger than the base of the pillar. Peel the backing off the pad, apply it to the pillar, then pop the Raspberry Pi on top.

The Cyntech Heatsink helps to keep your Raspberry Pi cool, but has a few odd design choices



The pillar contacts the SoC through a bundled oversized thermal pad

Another four screws, attached from underneath, pass through the heatsink and hold the lid on top. There's no way to leave the lid off, as the screws don't actually fasten into the heatsink, despite the metal heatsink providing plenty of protection.

With this much metal involved, not surprisingly, the heatsink's cooling performance is good. Running the standard stress-test workload – a worst-case combination loading both the CPU and GPU cores – the heatsink kept the test Raspberry Pi 4 running at full speed for the entire ten-minute run, without any thermal throttle events.

Sadly, so do significantly cheaper alternatives. At £6.59, the heatsink isn't too expensive, but you'll need to add the case on top for a further £5.99, bringing the bill to £12.58. If you want active cooling, you'll need a spacer for another £1.99 and the fan at £3.35 (all prices inc VAT).

Pimoroni's equivalent, the Raspberry Pi 4 Heatsink, costs just £2.40 (inc VAT), and works with or without a case. It's not quite as good at cooling, but it works well enough to complete the same stress-test benchmark without throttling and, unlike the Cyntech, works with most HAT add-ons. The Cyntech Raspberry Pi Heatsink is available now from **shop.cyntech.co.uk**, alongside the cases and optional fan. CPC

Gareth Halfacree is a keen computer hobbyist, journalist, and author. His work can be found at freelance.halfacree.co.uk @ghalfacree

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ANTONY LEATHER'S

Customised PC

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

AIO coolers sometimes need cleaning

Last month I tested NZXT's fabulous new H1 V2 mini-ITX case (see Issue 224, p28). I loved the original case, in spite of its PCI-E riser cable problem and issues cooling some graphics cards, especially Nvidia's RTX 3000-series Founders Edition cards, as its tiny footprint and easy build process made it very appealing. It was also easy to spray-paint, and there are lots of custom parts available for it too. However, the comparison between the old and new version of the case hit a bit of a hitch when I tested it last month.

Rather than using our usual mini-ITX test gear, I thought it more important to compare the original case with the new one to see if NZXT's claims were true about improved cooling.

In fact, it would be impossible to get a CPU temperature from this case that's comparable with other cases anyway, since H1 has its own AIO liquid cooler, rather than the cooler we use to test other mini-ITX cases.

I planned to drop an LGA1200 motherboard and a Core i9-11900K CPU into the H1 V2, and the new case coped very well with this CPU, despite it being a very toasty customer. In fact, I'd say even a Core i9-12900K should be fine in the H1 V2. The fact that the pump is set to full speed all the time was a slight concern, but thankfully it didn't prove to be an issue in terms of noise.

I've had a machine running in the original H1 for a few months now for various reasons, but it's not been under any heavy loads that would stress the cooling. However, I had seen the PC switch off a few times, which I suspected was down to Windows 11 gremlins. I stripped down that PC, made sure the case was clean for testing, and transplanted the new testing hardware across to the old model.

Despite using the exact same hardware, though, the PC wasn't playing ball. It would slow down dramatically, restarted a couple of times and, despite several tries, I couldn't even get the benchmarking software to run. Eventually, I hit the EFI to see if anything had changed, and it was then that I spotted the CPU temperature, which was close to 100°C. Clearly, something wasn't right, so I did some digging.

NZXT's H1 cases include a 140mm AIO liquid cooler

The pump/waterblock unit was making good contact with the CPU, and I'd opted to use LGA1200 instead of LG1700 in order to avoid compatibility and mounting issues. The fan was

Opening the pump/waterblock unit revealed that the waterblock flow channel was blocked with gunk

working and the thermal paste had a good spread. Powering on the PC seemed to indicate the pump was working too, as you could hear it spin up. I also made sure it was connected straight to the PSU, so it would be running at full speed without any interference form the motherboard.

Then I noticed something odd. One tube running from the pump was hot, while the other was the same temperature as my hand. Clearly, something wasn't right. I headed into the EFI again and connected the pump and fan to the motherboard – as I suspected, both were shown it as running, with the pump at its maximum speed of around 4,000rpm. However, it was very clear that the coolant wasn't flowing around the loop, or if it was, it was doing so extremely slowly.

Clearly, I needed to fix it, so I could get some results, and as the AIO liquid cooler in the new H1 looked slightly different from the original one, I couldn't swap that over either – the testing needed to be fair.

Perhaps the coolant level was low – that's a common issue in AIO liquid coolers, although it had barely seen more than a few months' use.

I opened up the fill port that was present on the radiator and the coolant was sat at the top. A little jiggling saw the level drop a bit as air bubbles rose, but I wasn't able to add more than a few drops of aftermarket coolant, and doing so had no impact on the dire processor temperatures.

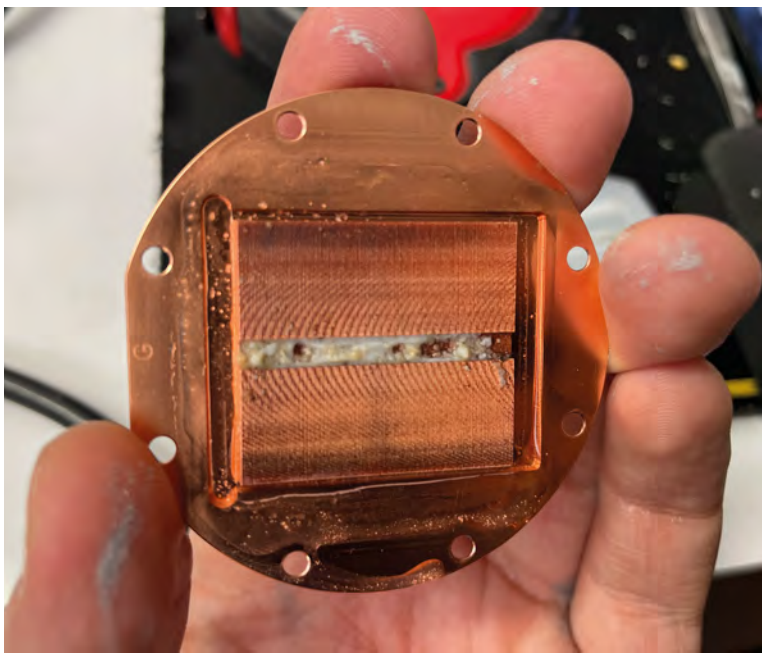
My last resort was to open the pump to see if there was an issue there. This was a fairly easy process, and just required removing a few screws. What I saw made my jaw drop. The waterblock was almost completely clogged with gunk. This gunk was clearly killing the flow rate and would absolutely explain why one tube was getting so hot. The coolant was basically sitting in the waterblock many times longer than normal and overheated as a result.

At least I'd found the cause, but it wasn't clear where the gunk had some from. The loop had been sealed, and the cooler worked fine when I first used the case. Clearly, this gunk had dislodged from somewhere in the loop, or some chemical reaction had taken place to create it, with the particles getting caught in the fine fins in the waterblock.

I decided to drain all the coolant and clean the waterblock, since it was relatively easy to dismantle. Putting it back together again saw temperatures back to expected levels, but within five minutes, they started climbing much higher. Sure enough, on opening the pump again, there was more gunk, so I flushed the loop again, ran the pump and continually drained it to get rid of as much gunk as possible.

Eventually, after an hour of running, the pump was still gunk-free when I opened it up for the fourth time. This is pretty disconcerting, though, given that the liquid cooler and case were under two years old and had been in regular, but not constant use. In fact, searching online saw dozens of forum posts with NZXT H1 users reporting pump failures and returning their cases. That's a shame, because a ten-minute loop clean could solve the issue.

Of course, this shouldn't happen in the first place and it could be another reason why NZXT revamped the H1. However, in this month's How To guide (see over) you can see how to fix this issue if you experience it with your own liquid cooler, using our step by step instructions. If it's more than two years old, I'd definitely recommend it, as it's very simple. All you need is some third-party coolant, plus an hour or two of cleaning, and your liquid cooler should be good for another two years of operation. CPC



It's simple to fix, but the clogged waterblock was causing the CPU to overheat

Antony Leather is Custom PC's modding editor @antonyleather

How to Use a vinyl cutter

Antony Leather shows you how to use a vinyl cutting machine to create eye-catching case artwork and painting stencils

TOTAL PROJECT TIME / 2 HOURS

Wrapping your case or hardware in vinyl, which we explored last month, is very different to creating patterns and text that can be applied to surfaces. The latter is usually a much more intricate process, and it can be very difficult and time-consuming to create vinyl cut-outs by hand with a scalpel. This is where a cutting machine comes in.

These machines can cut out vinyl for you with perfect precision, leaving you with the task of just transferring the vinyl to your PC. You can even use masking vinyl to create accurate masking patterns for spray painting, which would take hours to cut out by hand and likely have inferior results.

TOOLS YOU'LL NEED

Vinyl application squeegee
amazon.co.uk

Spray paint
fatbuddhastore.com

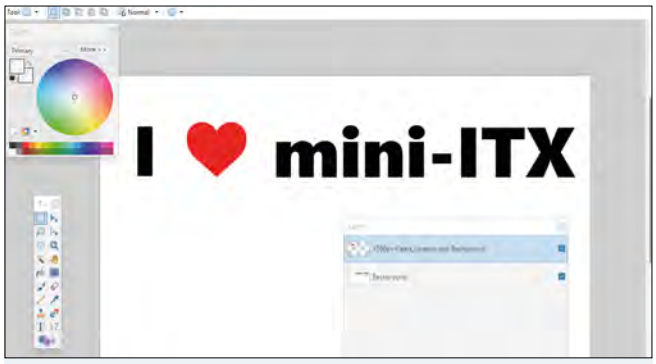
Adhesive masking vinyl sheet
gmcrafts.co.uk

Clear transfer/ application tape
hobbycraft.co.uk

Cutting machine
yolo.co.uk

Adhesive vinyl sheet
yolo.co.uk

VINYL CUTOUTS



1 / CREATE DESIGN

You need a bold image with which to work, so you can use a cutting machine's software to trace the edges and cut it out of a vinyl sheet. This can be an image, design or text you've created yourself, or an image you've downloaded.

2 / STAY WITHIN BORDERS

Import the image into the cutter's software and drag it into the trace area. The design needs to sit within the print area borders, but cutting machines can easily deal with long lengths of material, so make sure you use the correct borders and stay within them in the software.

3 / SET TRACE AREA

Configure the software to trace around the edges. All vinyl cutting software is different, but you usually need to tweak the settings to adjust the cutting lines, so the machine will only cut along the edges. Check the instructions.

4 / SET CUTTING DEPTH

Your cutting machine will tell you the correct depths to set the cutting blade for different materials. This is usually set manually on the blade section itself. This helps to cut only the material you'll be transferring, and not any backing material – using the correct depth is key.

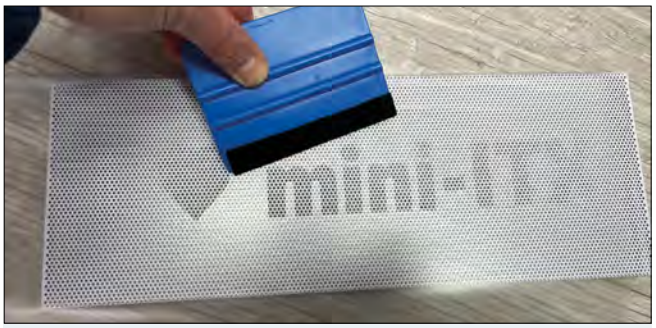
5 / PRINT AND REMOVE CUT-OUTS

The cutting process usually takes just a few minutes, and then you can start the process of using a pick to remove any unwanted inner sections of your design. You need to only leave behind the pattern you want to transfer.

6 / LIFT AND APPLY TO CASE

Lift your pattern off the vinyl backing paper and stick it on your PC. This might need some persuasion to lift it off the vinyl backing paper. Occasionally you may need to use a scalpel to encourage it to lift off. Remove the transfer paper at an angle to help ensure the vinyl is left behind.

PAINTING STENCILS



1 / USE MASKING SHEET

A cutter can also cut masking vinyl, which you can use instead of masking tape for spray painting, enabling you to create precise masks. You can use the same process to cut it out as the coloured vinyl, or create a large mask. Use a squeegee or credit card to press the mask onto your case.

2 / SPRAY OVER THE MASK

Use your spray paints to add paint to the exposed areas. You only need one or two coats, but it's important to remove the masking before the paint fully dries, ideally within five minutes.

3 / REMOVE MASKING SHEET

Peel off the masking sheet slowly. If there is any overspray or paint creep, this can be remove with isopropyl alcohol. If you need to start again, acrylic spray paint remover can be used, or you can simply spray over the panel using its base colour, which is white in this case.

How to Renew AIO liquid coolers

Antony Leather shows you how to clean out an aging all-in-one liquid cooler and give it a new lease of life

TOTAL PROJECT TIME / 1 HOUR

The radiator units with all-in-one (AIO) liquid coolers often serve two functions. Firstly, the radiator acts to cool the coolant passing through it. Flow channels and heatsink fins allow the heat to be transferred from the coolant into the surrounding air blown through it by active fans.

However, AIO liquid cooler radiators often act as reservoirs too, trapping air at one end, and preventing it from circulating in the loop and reaching the pump. If the latter happens, it can cause unpleasant noises and over time can even cause the pump to burn out. Out of the box, liquid coolers are filled to the brim with coolant, but this can evaporate over time, increasing reliance on the radiator's reservoir area to trap air. If you orientate the radiator the wrong way, this air can escape, causing increased noise and pump failure.

As we've seen in this month's Customised PC (see p102), gunk can also form inside the loop, clogging the waterblock. Thankfully, refilling your loop with new coolant and cleaning clogged waterblocks is a cheap and easy job, so rather than buying a new cooler, try these steps first to see if they boost cooling.

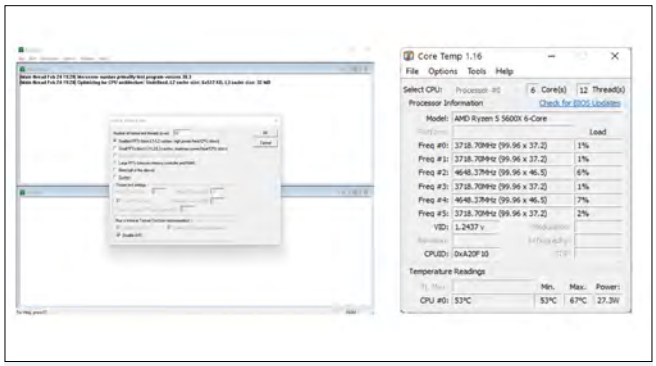
TOOLS YOU'LL NEED

Draining container
Most hardware stores

EK Cryofuel
overclockers.co.uk

Air duster
Most hardware stores

Micro screwdriver kit
Most hardware stores



1 / CHECK TEMPERATURES

If your AIO liquid cooler isn't performing well, or its pump has become noisy, it might have a low coolant level or a clogged waterblock. Run the smallest FFT test with all AVX options disabled in Prime95 (**mersenne.org**), then check the temperature with CoreTemp (**alcpu.com**) – if it's above 85°C at stock speed, there could be a problem.

2 / CHECK TUBE TEMPERATURES

If the waterblock is clogged, you might find one length of tubing is hotter than the other. This can be caused by a clogged waterblock that's reducing the flow rate so the coolant spends too long in the waterblock.

3 / REAPPLY THERMAL PASTE

It's worth cleaning off old thermal paste (with TIM cleaner and a lint-free cloth), reapplying it and remounting the cooler if you spot high temperatures. This can potentially save you dismantling the cooler. If your cooler came with paste pre-applied, you'll need to by a separate tube such as Corsair XTM50.

4 / REMOVE CONTACT PLATE PASTE

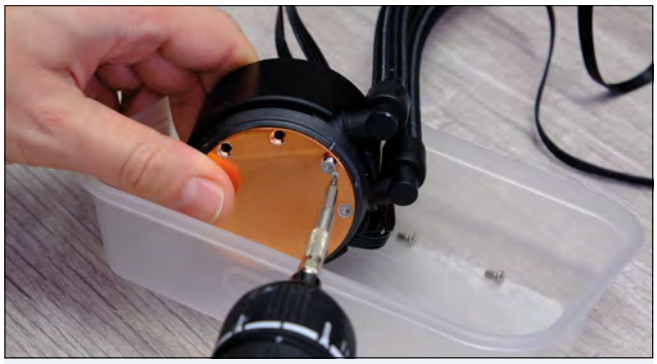
If step three fails to improve temperatures, you'll need to remove the contact plate. This will allow you to check the coolant level and whether the small metal fins inside are clogged. First, remove the thermal paste on the contact plate, or it will get everywhere.

5 / IDENTIFY WATERBLOCK OPENINGS

Most AIO liquid coolers have contact plates held in place with a dozen or so screws. These are easily removed with a micro screwdriver, but check the fitment first, as they're often star or hex head screws, requiring the right tools.

6 / USE A DRAIN CONTAINER

The coolant can spill the instant you start removing the screws, so be sure to use a draining container to catch it and avoid making a mess. You'll need to flush the coolant too, so use a container with at least a litre of capacity.



7 / REMOVE SECURING SCREWS

Loosen the contact plate screws by two turns, working your way around until you're back where you started, then fully remove them in the same manner. This will prevent the block from popping open and potentially shifting its internal parts before you get to make a note of what goes where.

8 / PRY OUT CONTACT PLATE

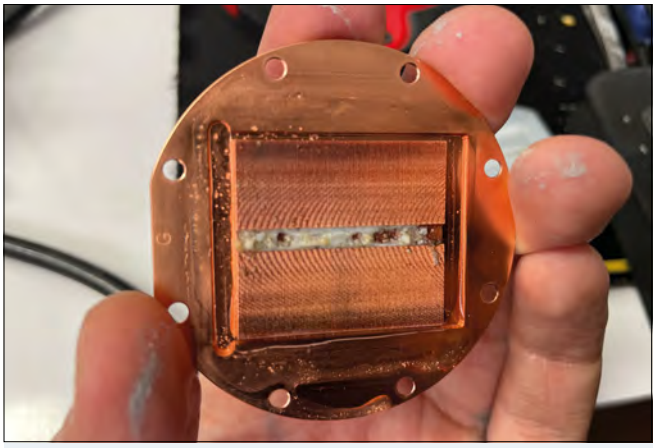
Place the screws somewhere safe, then lift the contact plate out of the pump section. You may need to pry it out with a flat blade screwdriver if it's stuck, but don't apply too much pressure. Make sure you do this over the draining container, as coolant will likely spill out.

9 / PHOTOGRAPH INTERIOR

It's important to remember where all the parts go, so you can reassemble the pump section once you're done. Grab a photo on your smartphone, taking several in various stages of deconstruction as necessary depending how many parts there are.

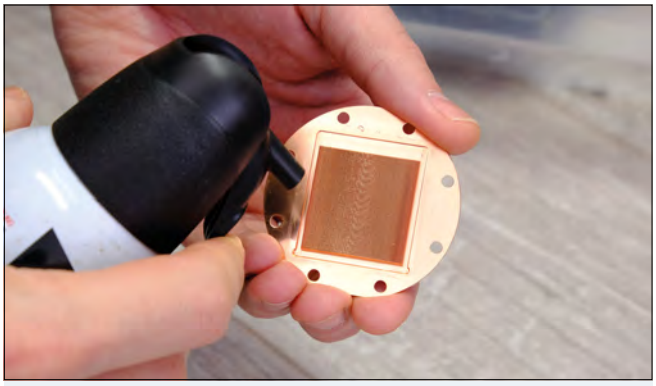
10 / INSPECT COOLANT LEVEL

If the coolant level appears to be brimmed when you open the cooler, you likely don't need to add any more, and lack of coolant isn't the cause of any high temperatures. If you can't see the top of the coolant level, then it's possible that some has evaporated out and needs to be topped up to avoid problems.



11 / INSPECT CONTACT PLATE FINS

Before you add more coolant, check the contact plate fins. Hopefully, yours won't look as bad as this, but even small blockages can have a big impact on temperatures.



12 / CLEAN CONTACT PLATE

You'll need to clean the contact plate with an air duster or under a tap on high pressure. The fins can be delicate, so it's best not to scrub them. Any obstructions or gunk will be easy to spot and need to be removed.

13 / DRAIN COOLANT

It's best to drain all the existing coolant if the level is low or you find gunk in the contact plate. This way you won't be mixing coolants, and if there's more gunk, hopefully a flush will get rid of any that remains.

14 / FLUSH LOOP

New coolant should have anti-corrosion and biocide protection and we recommend EK Cryofuel mixed appropriately. Flush the loop by filling it with the new coolant, insert a straw into one port on the pump and blow to force the coolant through. Repeat this three times, discarding flushed coolant.

15 / REASSEMBLE LIQUID COOLER

Reattach the contact plate, connect the cooler to its power connector in your PC, but don't install the cooler just yet. Power the PC on for ten seconds, no more, then switch it off. This may dislodge remaining gunk in the loop. Open the contact plate again and check for any more detritus, repeating as necessary. CPC

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- **Stuart Turton**, bestselling author and journalist

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Readers' drives

Alien Breach

Game over man, game over! Mick Black takes us through the process of building this desk-based build inspired by the Alien universe

From a young age I've always been drawn to the Aliens universe. I remember my mum leaving me to dog-sit one evening and I couldn't find anything to watch. I picked up the VHS of Aliens and threw it in our toploader thinking it would be fun. Being only 13, I was absolutely terrified, but I made it to the end. It left me intrigued and in total awe of such a brutal creature.

/MEET THY MAKER

Name Mick Black

Age 40

Occupation Electrical engineer

Location Plymouth, UK

Main uses for PC Gaming, light video editing

Likes Star Wars, 1980s movies, hiking with my wife Siobhan, and my dogs Tia and Evie, thrill rides that make me sick!

Dislikes The feel of age creeping over me and I still have lots I want to do!

My old PC had done me proud over the years but it was starting to struggle with today's AAA titles, so it was that great time to build another. I have seen many, many builds over the years, but they all have (mostly) one thing in common – a square box with colourful fans in it. I wanted to push my capabilities.

Firstly, I will state that I am no carpenter, artist or wizard. I took my time, and built it bit by bit. Lots of test pieces and prototypes were thrown at walls in the process! It was trial and error. I wanted to make a machine that was dark, dirty and gritty, to move away from the clean, shiny builds with perfect edges. I wanted catwalks that were twisted, pipework that was bent and rusted, oil spills and stains. I wanted to almost hear the hum of powerplants and steam leaking from decaying boilers and of course, the distant screams of terror echoing down the halls.

A few years ago, I was frustrated that I couldn't find a suitable desk for my PC room, so I went out and bought the largest piece of wood I could fit in my van. I made my desk one afternoon, and it reached from the door along the whole wall to the window. This was later to be my canvas. I started out by measuring the largest square I could cut into the desk without affecting its structural integrity.

I then made this shape out of thick white cardboard. After researching the components I wanted, I then made basic cut-outs of them from the same cardboard, began arranging them and brainstorming ideas. Originally all the components were going to be housed inside the same piece, but it would have looked very cluttered, which would have distracted from the overarching effect. As a result, I mounted the PSU externally.

The next job was working out where to house the graphics card. It was taking up valuable real estate in the area I had, so I looked at risers, and found that you could get 1m riser cables. I bought a high-end Akasa XL 1m riser cable, which opened up a whole new design element to consider.

SYSTEM SPECS

CPU AMD Ryzen7 5800X

GPU Nvidia GeForce RTX 3080 Founders Edition

Storage 500GB Samsung 970 Evo Plus (OS), 1TB Samsung 970 Evo Plus (game drive), Samsung 870 Evo (storage drive)

Memory Corsair Dominator Platinum 32GB 3600MHz

Motherboard Asus ROG Strix F570-F

PSU Corsair RM850x Gold

Cooling ARCTIC Liquid Freezer II 420mm AIO liquid cooler, 4 x 140mm ARCTIC P14 fans, 2 x Lian Li AL120 fans

Hot as hell in here

After a few days of thinking I decided to add another layer to my build. The base structure of the build is 0.5in plywood made into a box. I then built a separate layer for the graphics card. My design always had two fundamental rules to which I returned if I became indecisive.

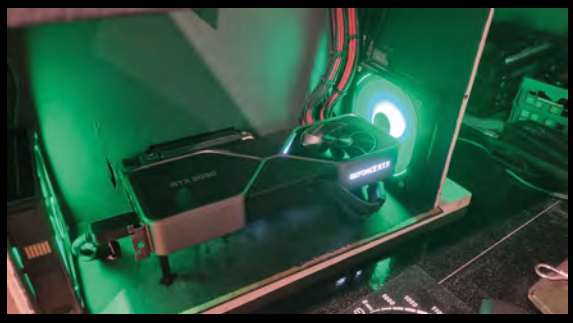
The first was to make sure that PC performance came first. Each component was bought because it was the best at what it did and what I needed it for – not because it had cool RGB lights, flashy-looking fans or LCDs. The CPU AIO liquid cooler, for example, is an ARCTIC Liquid Freezer II 420mm. No gimmicks, no RGB, just decent cooling. It was also handy that it's dark and fits the build.

The second rule concerned cooling. I was very aware that pieces of modelling work were going to be fitted around components, and could become very hot. I was already removing the PSU and graphics card out of the main housing, but I also I rigged four 140mm ARCTIC P14 fans (again, no RGB) at the front pulling fresh air into the machine, with the fans on the 420mm radiator at the back pushing out the warmer air. The motherboard is also raised 0.5in from the floor to allow airflow underneath it.

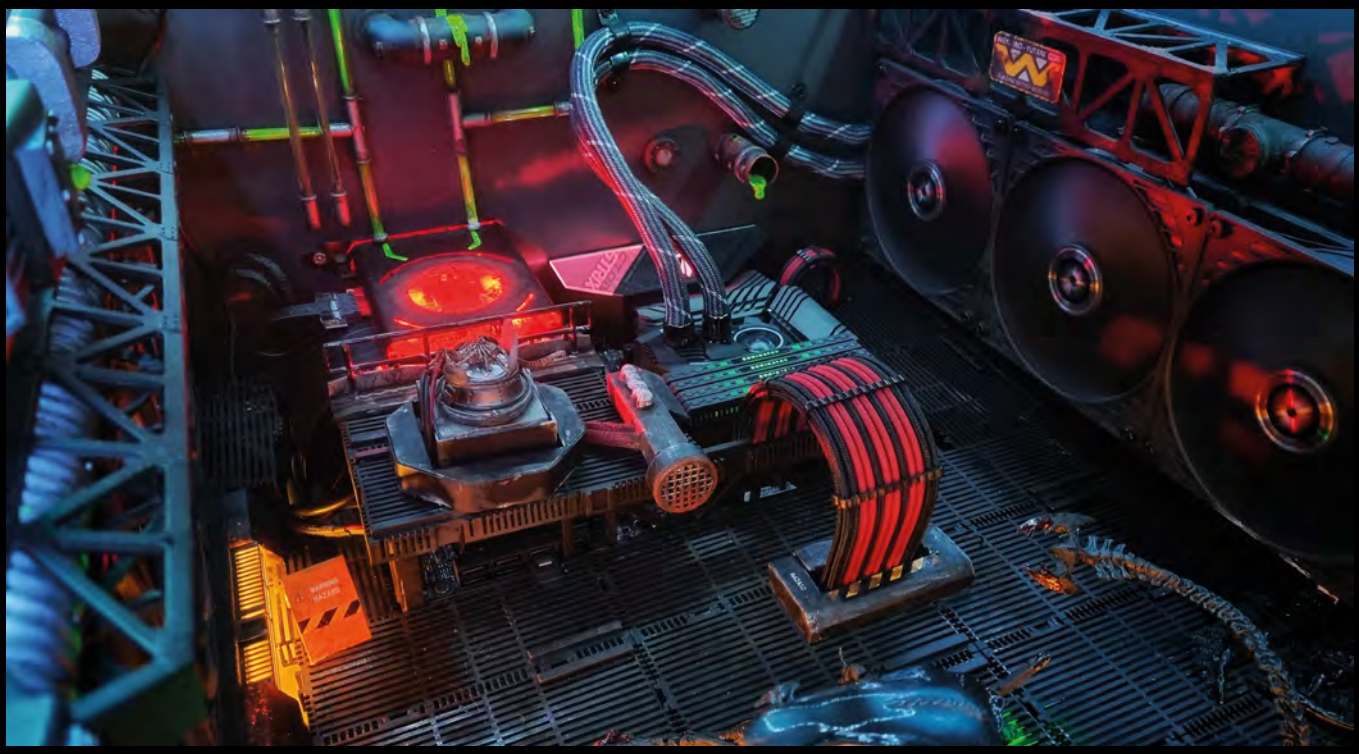
The PSU is side-mounted on the case, with all its cables running through a conduit around the back, because cable management tight! Meanwhile, I wanted the graphics card mounted under the main display area, but to be visible. After much toing and froing (and maybe a whiskey), I cut a massive hole in the floor of the main housing.

The graphics card resides in its own cavity beneath (what will be later) the star attraction. It has its own Lian Li AL120 fans in front and behind to push/pull over the card (and yes, these ones have RGB!). I was lucky enough to snag a GeForce RTX 3080 Founders Edition at MSRP. I was holding out for one, as I believe they offer the best bang for buck you can get in these times.

However, this card doesn't sport much in the way of lighting effects, and it was very dark down in the graphics card cavity. After a few hours watching reviews on YouTube, I liked not only how well the AL120s performed, but also the amount of flexibility with lighting options they offered.



I wanted a haunting green glow that faded in and out of the area, and I also changed the orientation of my sound card. I liked the round top opening showing the circuitry inside, so I bought a riser cable for it. I sprayed it black and then went to work painting and detailing it. This is the component you can see above the PCI-E slots. It also hides the 1m GPU riser cable that disappears through a hole underneath it.



Show me everything

Next we come to the modelling. I wanted this piece to look as if it came from the universe that terrified me as a kid, with sci-fi bulkheads, floor lighting, catwalks and rusty pipes. I grabbed another whiskey, and watched hours of modelling YouTube videos learning tips and tricks. I used fish tank filter grids for the floor. They were perfect – cheap, easy to cut and already black. I found a kit from a tabletop gaming company that sold industrial model pieces, so I stocked up on pipework.

I then checked on local selling pages for old toys I could cut apart and use. I found a large broken toy crane, some of which forms the rusted pipe shroud above the AIO coolers radiator. I also repainted and weathered a kids' build-your-own straw kit to form yet more pipework. I used foam boarding and a Dremel saw to craft shapes for the bulkheads to give the area that sci-fi feel. I sealed this with Mod Podge ready for painting.

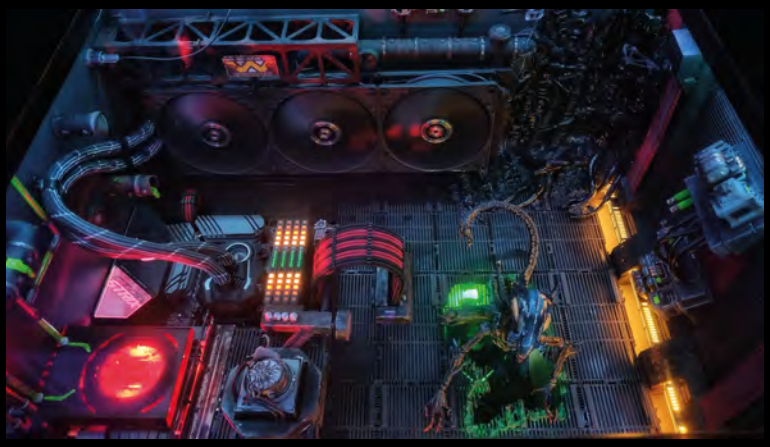
When it comes to the floor lighting effect, I used Phanteks ARGB strip lights. There are two strips connected via a controller hidden under the floor grille. Again, I wanted nothing flashy for this, just a yellow hue to cast across the floor to signify a warning light. I originally planned for this light to be red, but that ended up looking too dark and too much of the build was already lost in darkness, so I went with yellow instead.

I then went back to YouTube for painting and detailing school. I used Citadel paints for the modelling work, and I really enjoyed layering paints and testing different effects. I built up rust over many layers, using washes and Games Workshop's technical paints to get gritty and worn effects.

One of the main effects involved mixing green paint with Mod Podge, and leaving it in a pool overnight to see if I could create a green acid puddle. It was a success, and I cut away the filter grid above my graphics card cavity and melted the edges with a gas lighter.

I then layered up the edges of the filter grid with a sandy textured gritty paint, left it to dry and then began adding the green – I finished it off with gloss varnish to create that wet look. A similar effect was used for the dripping pipes – Mod Podge mixed with green paint, which I allowed to run out of the pipes and then stole my wife's hairdryer to set it. I finished off the drips with some Citadel Technical paint to create that acid deep effect.

Next was the dreaded Alien hive mucus, for which I went back to YouTube. This was one of the hardest parts to get right, and I still may revisit it. I couldn't find an Alien diorama that anyone had got quite right. People had tried using expanding foam, and old pieces of cables, but none of the examples I saw looked good enough.



I bought some airdrying clay, and after a week of cursing, trips to the shop to buy more, scrubbing stains out of the carpet and, yes, many whiskeys, I put together something that satisfied me. I painted it all black with more gloss varnish to create that nice wet look. I used some PVA glue poured into thin strips allowed to dry the peeled off my work surface to use as detail for the hive mucus.

They're coming out of the goddamn walls!

It was then time for the centre piece, for which I needed the right Alien model. To be honest, this was one of the first things I bought. After flicking through Google Images searches of Alien action figures I found that most fell into the 'kids toy' bracket. I wanted something that looked detailed and monstrous. I came across one made my Square Enix and I knew the build quality would be top-notch, as I have a Boba Fett statue made by the same firm and love it.

The only problem is that it's quite rare. I had to ship it direct from China and it took weeks to arrive. I was very pleased with the figure when it arrived, but I still had to put my own twist on it. I repainted parts to accent the acid running inside and through its veins. I also added a wet blood effect to its jaw, claws and blade-like tail.

I finished the piece with a wash of varnish to give that it that wet and slimy effect. I then formed his limbs into the right positions and placed him into his final location, climbing out of the melted acid floor above the graphics card cavity. Sealed below 12mm of custom-cut toughened glass, he waits silently for his next sacrifice ...

I enjoyed making this build from start to finish. I enjoyed the challenges that I encountered and spending hours, sometimes days, figuring out how to solve them. Sometimes I went to bed frustrated that something else didn't fit, or look right. Other nights I went to bed excited that I had just completed a part that looked awesome and I wanted to do some more. I hope this build inspires others to make that jump, to step outside their comfort zone and try something different.

> I wanted catwalks that were twisted, pipework that was bent and rusted, oil spills and stains

Just take one small step at a time, slowly build up your parts and don't rush anything. The only limit is your imagination. CPC

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Corsair Hydro X Series XD3 RGB Pump/Reservoir C

WORTH £151

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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 a version for Intel or AMD CPU sockets.

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WORTH £55

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JAMES GORBOLD / HARDWARE ACCELERATED

STEAMOS FINDS ITS MARK

Forget faffing around with gaming laptops, James Gorbold wants a Steam Deck

Although the first quarter of 2022 has been relatively quiet in terms of new hardware, with new CPUs and GPUs being delayed for a variety of reasons and still a little way off from being released, Valve may have finally cracked the conundrum of how to break the Wintel alliance.

I'm talking about the Steam Deck, a truly innovative portable gaming PC that puts hot and noisy gaming laptops running Windows to shame. Armed with a 7in screen, AMD CPU and GPU, plus a battery that lasts over two hours, the Steam Deck eschews Windows in favour of SteamOS 3.

SteamOS isn't a proprietary operating system like Windows, but a customised version of the Linux distribution Arch. You can trace the ancestry of SteamOS to way back in 2013, although it was based on the Linux distribution Debian at that point.

Unlike Windows, macOS or Linux, SteamOS is designed with one primary task in mind – running your favourite Steam games.

Yes, you can browse the web and watch films on SteamOS, and even do your tax returns on it, but first and foremost SteamOS is all about playing Steam games. In this regard, SteamOS is in some ways similar to the gaming-dedicated operating systems found on game consoles, although not nearly as restrictive.

Scan was closely involved with Valve and SteamOS from the very start, and working together, we developed the UK's first Steam Machines in 2014. These dedicated gaming machines weren't really intended to compete with traditional gaming PCs, but were supposed to be leaner, quieter and more stylish. What's more, with the gamepad-like Steam Controller, they could even be used from the sofa quite comfortably.

Unfortunately, the promise of Steam Machines never really materialised, due in part to their high cost compared with consoles and limited game library compared with Windows. As a result, Steam Machines never really sold in big numbers and SteamOS faded away back into obscurity.

This time, however, I think the new SteamOS-powered Steam Deck has a real chance of disrupting the market. For starters, unlike feature-limited Steam Machines, which were trying to compete at the same price with fully featured Windows-based gaming PCs, the Steam Deck's real competitors are portable consoles such as the Nintendo Switch. While it's fair to say the Switch is thinner, lighter and cheaper than the Steam Deck, it's also based on old tech, so it can't run contemporary games at high detail settings.

> SteamOS is designed with one task in mind – running Steam games

The Steam Deck also has access to the vast Steam game library, with thousands more titles now available than when Steam machines went on sale in 2014. You can even access the Linux desktop if you really want to do your tax return.

I'm wary this column might sound like an advert for the Steam Deck, so for full disclosure, Scan has had no involvement in this product and I'm writing from a purely personal perspective. I'm just a PC gamer and tech enthusiast who is genuinely impressed by the Steam Deck, not just for what it delivers but also what it means for portable gaming.

After all, despite technologies such as Nvidia Max-Q helping to slim down gaming laptops, these systems still aren't really portable gaming systems. So-called gaming laptops have a battery life measured in minutes rather than hours, and an OS (Windows) that's designed for every possible computing use on the planet, rather than a streamlined experience for gamers. Even though we've been here before with Steam Machines, this time it feels different with the Steam Deck. Who's up for some PC gaming in the park? **GPC**

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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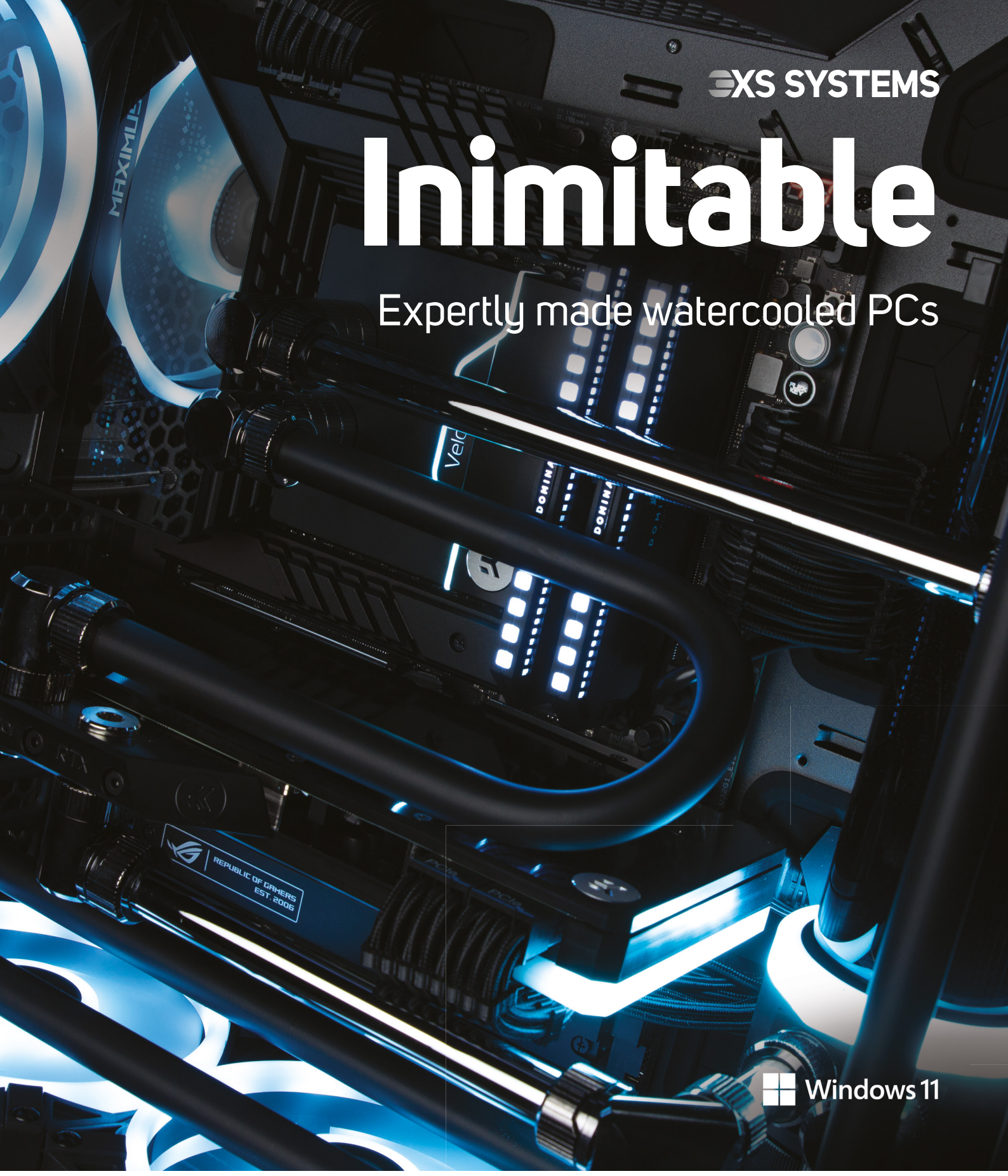

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