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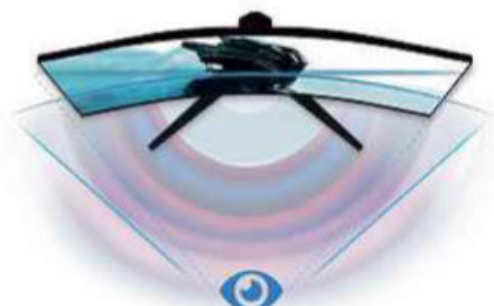
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We’ve featured many guides over the years on how to improve and upgrade your desktop PC, whether that’s by adding new or better hardware or via software tweaks.

The huge advantage with desktops is their longevity, thanks to the ability to upgrade pretty much every component. Laptops, on the other hand, have a reputation as being nigh-on impossible to upgrade.

In some cases, this is true, and the only option for an ailing or ageing laptop is to pass it on to a friend or family member who’s more willing and able to put up with a slow or unreliable device, or consign it to the recycling bin, while you go and buy yourself a shiny new machine.

However, many laptops can be tweaked and improved under the hood, as our guide on page 112 reveals. Memory, storage, docks, graphics cards, Wi-Fi cards – all of these components can be enhanced or added to a wide range of laptops, with little more required than a screwdriver and a bit of cash to buy the new parts. So it’s definitely worth checking to see if your model falls into this category before you ditch it.

With the ongoing focus on reusing and renewing kit rather than adding to landfill, you’d be doing the right thing for the planet, and for your wallet.

We’ve also been hard at work testing out external SSDs, for those of you wanting a quick and easy boost to your computer’s storage (page 78); and comparing nine speakers, from portable devices to smart models, for those of you wanting to get better – and more intelligent – sound around the home (page 64).

Madeline

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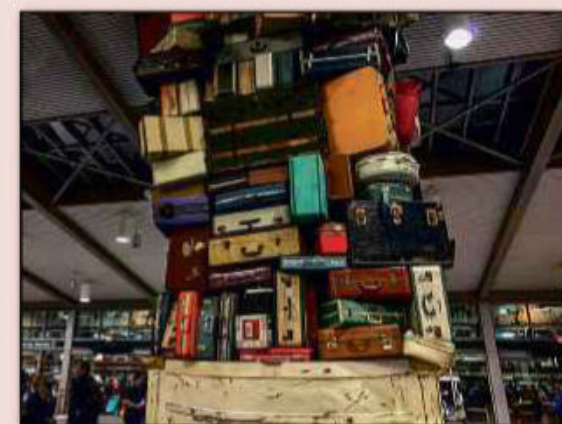


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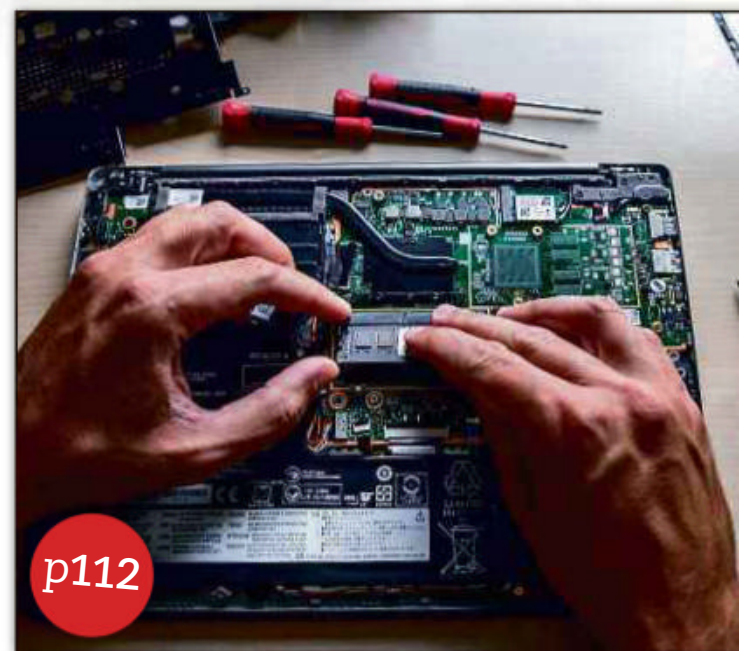




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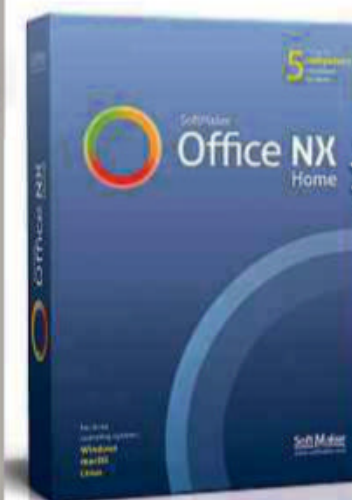


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# Letters

No need to adjust your specs: one reader thinks Mel Croucher's got it wrong, while another thinks Microsoft doesn't get enough credit

 letters@computershopper.co.uk

## Off colour

**@** In Mel Croucher's column discussing the lack of representation of minorities in video games (*Shopper 393*), it's unfortunate he chose to do so by bashing developers who were early pioneers in doing just that. Of the three versions of Daley Thompson's Decathlon released, only the Spectrum version used a white player sprite due to the limitations of the Spectrum's colour palette; both the Commodore 64 and Amstrad CPC versions used more realistic likenesses because they were able to.



When I met Daley Thompson some time ago, he said he was proud of his association with the game and was pleased that it introduced him and his sport to an entirely different audience.

Criticising Michael Jackson's Moonwalker is equally baffling, as this also featured as true a likeness of the artist as the technology allowed. The plot of Jackson rescuing children was taken from the film, and not, as Croucher seemed to be implying, some thinly veiled suggestion that Jackson was a deviant.

Perhaps instead of encouraging us to put our knees into the groins of developers who have actually done their part to make a difference, Croucher should focus on removing his own foot from his mouth.

Michael

## Printer's progress

**@** My trusty Canon iP4000 printer died on me recently, after 11 years of service, so I had to buy a new printer. I put together a list of 'must-haves' based on the features I liked with my old Canon.

1. Cheap to run. I used compatible cartridges and it cost me £10 a year for the ink.

## ★ Star letter

### Old phones for new

**@** *Shopper 393* provides a great deal of information on choosing a new mobile phone, which is very useful. However, because we don't use mobile phones very much for calls, for some years I have adopted a different approach: upgrading with new old stock models.

My first smartphone was a new Samsung Galaxy S3 Mini, bought outright from a high-street shop with a SIM-only deal from O2. A year or two later, BT launched back into the mobile market and I took advantage of its most basic SIM-only contract, discounted to £5 per month for BT broadband customers. It's a great deal, which we still use and is still a current offer.

When my wife decided to get a phone, I shopped around and found that several eBay traders were offering the Samsung Galaxy S5 at very attractive prices when the latest model was the S7. These were new, sealed in Samsung boxes. I bought her an S5 Mini and after setting it up, subsequently bought a full-sized S5 model for myself. We have been using these very happily for four to five years. From new, they have been kept in cases with fold-over front flaps and glass screen protectors.

Recently we decided to upgrade our phones, and I used the same approach. I found an eBay shop selling the Samsung

Galaxy S9 for £319 including postage (new, with stock located in the UK). This is at a time when the current S20 retails for £800+.

Two were purchased and arrived three days later: new, sealed in their Samsung boxes, with additional free screen and back protectors. One was faulty, failing to connect with the SIM card, but it was swiftly replaced with another new one by the trader. We are delighted with these new phones, which do not appear to be significantly inferior in spec to the current S20. We have saved approximately £1,000 sourcing two S9s instead of S20s.

Nor have the old Samsung Galaxy S5s gone to waste. A relative on limited means, who has never owned a smartphone, has gratefully accepted my full-sized Galaxy S5, which also doubles as a satnav in her car.



The Galaxy S5 Mini has been re-purposed as a music streaming wireless/Bluetooth media controller. After a factory reset, disabling email and setting the screen to maximum brightness and longest screen-on time, it sits permanently on in a charging cradle in the lounge.

I use the UNDOK app to operate our three Roberts music-streaming internet radios, Yamaha MusicCast to operate my Yamaha WXC-50 hi-fi music streamer, and Hi-Fi Cast (or other apps) to stream music to my UE Bluetooth speakers or Cambridge Audio Melomania 1 Bluetooth earplugs.

Music is stored as FLAC files on my Synology NAS. The Galaxy S5 is therefore a very convenient (always fully charged and on) music controller.

R G Willis

### » Write in and win

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with a 500GB MX500 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

This SSD is 45 times more energy-efficient than a typical hard drive, and has sequential read and write speeds up to 560/510MB/s and random reads/writes up to 95K/90K IOPS, making it the perfect replacement for the ageing hard drive in your sluggish PC.



**STAR PRIZE**  
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2. Duplex two-sided printing.
3. Small footprint with the option to run it under the desk with easy access only to the front.
4. The ability to print directly to a printable CD or DVD.

- a. I only managed one of the above with a printer that had ink tanks.
- b. Duplex? Seems to be only available on some printers with expensive ink.
- c. Small footprint? Same again.
- d. Print to CD and DVD? As far as I can tell, there isn't one. Back to the stick-on label kit.

The new printer, being an all-in-one device, has a scanner, but I have a separate scanner already. The scanner lid on the new printer doesn't have expandable hinges for copying books. Unlike my old scanner, which does, but I have no room for.

So now I need easy top access. There goes my 'under the desk' option. No slide-in paper tray to keep and feed the A4. Just a floppy slope thing at the back, which the A4 has to share with the photo paper. No duplex, so it's back to printing multi-page documents by printing all the odd numbers first. Reverse the order of the printed stack then print the even numbers, making sure to feed the stack in the right way round.

The new printer has wireless function but as I always tweak my photos, this is a feature I have no use for. I will not mention

the make or model of the new printer because there is nothing actually wrong with it. It just does a lot of things that I don't need and doesn't do some that I do. It was the best compromise.

What I really wanted was a new printer exactly the same as the old one. So instead of being excited with my new all-in-one wonder machine, I'm left feeling that I have paid good money to end up with something that will print documents and photos – effectively a bigger, space-hogging version of the printer I had before I bought the previous one, about 15 years ago.

Joe Gentile

### Word up

@ It's clear from the letters that are published in both this and other computer magazines that finding fault with any Microsoft product is the norm. I can only say that in my limited experience of its operating systems from 3.1 – on which I created my first web page using MS Front Page – to Windows 10 and its myriad of options, that Microsoft has to be applauded.

It offers so much, from an easy sync and backup program to MS Office and its plethora of applications. I have recently written a non-fiction book on a circumnavigation by yacht and I couldn't find an alternative to Word that came even close. When it comes to details like indexing, placing images or page numbering, Word is to my mind amazingly good. Conversion to PDF/A or any other format is also so easy, and the autosave feature saved me from losing the document more than once.

I know that product-bashing will always continue, and especially so with the more predominant products, but I hope that your readers will apply some perspective and recognise that the scope, options and benefits that Microsoft gives us can be acknowledged and appreciated.

Incidentally the book, available on Amazon, is called *Chasing the Sunset*.

Tom Sampson

### Unfit for purpose

@ I have been subscribing to *Computer Shopper* for a few years now, and apart from it being a good read, I have come to trust the reviews offered. I have bought a number of items based on these reviews and recommendations, and have not been disappointed – until now.

I was looking for a reasonably priced, basic fitness tracker for my wife and me, and decided on the Fitbit Inspire HR, which seemed to fit the bill and is one of your 'best buys'.

As far as fitness tracking goes it does what it's supposed to, but problems arise when it comes to syncing with the 'top-quality mobile app'. The device refuses to sync at least once a week and sometimes more frequently, for no apparent reason.

This issue seems to affect a significant number of people, looking at the online forums where I attempted to find a solution. I use the word 'attempted' as none of those solutions offered by Fitbit has worked. The only solution that seems to work for me is to clear the user data on the device (which sort of defeats the object of it) and reinstall it from scratch on to the tracker software on my phone.

Given the frequency with which this happens, I find it hard to believe that your reviewer didn't experience this issue – maybe he was just lucky? Or perhaps it's just a ploy to get me to take the premium software option (which is not going to happen, given my experience)? Anyway, it seems difficult to reconcile the rating of 'best buy' with the problems that this device has, and I'd suggest that it would be worth reviewing again to establish whether it really is worthy of the rating.

Mike Hadfield



## In the next issue

### » Build your own cloud

How to get expandable, secure, access-anywhere storage, all hosted from your own home



### » Read all about it... again

We get the lowdown on two iconic games magazines from the 1980s, which are crashing and zapping their way back as regular publications



**COMPUTER SHOPPER ISSUE 395 ON SALE IN NEWSAGENTS FROM 12th NOVEMBER**



# Hoarder control

**Mel Croucher** has a huge music collection that goes right back to the earliest days of recording, but his new project eschews physical formats for the benefit of the artists



## MEL CROUCHER

Tech pioneer and all-round good egg  
letters@computershopper.co.uk

**I RUN A** platform called *jeeni.com*, which is where independent artists perform their music in front of new fans, then try to pimp, ponce and wheedle rewards. Last Saturday night we ran a live global music festival featuring 18 acts from both sides of the Atlantic. The oldest performer was over 70, the youngest was under 10. They were brilliant, each in their own way. We broadcast over social media and websites. There were no adverts, there were no fakes, there was no hype. It didn't cost us a penny to run. Everyone had a ball. We are part of a revolutionary process that is killing a corrupt and rotting music industry, which has held both audience and performer to ransom since the 1890s. So if you will indulge me, I'd like to tell you how, and why.

I'm an old hoarder. I hoard old music recordings, and when I say 'old' I mean really old. Upstairs, in what was once a studio but has turned into an Irish setter leisure lounge, there are several hundred wax cylinders from the 1890s. Each cylinder is a unique recording from an age before

of the 20th century, discs replaced cylinders, but not a lot changed. I have another room full of shellac discs that spin at 78 revolutions a minute. When it came to pop singles from artists bringing joy to the world throughout the first half of the 20th century, they had just under three minutes to do it in. And if they were any good, just under three minutes was plenty.

## BORN UNDER A BAD SIGN

I feel personally to blame for what happened next, because in the hour of my birth in 1948, the microgroove vinyl disc hit the market, spinning at what my Irish chums call 'dirty tree and a turd revolutions per minute'. I have an entire wall of vinyl albums, with their glorious covers and sleeve notes. And yes, they are arranged in alphabetical order by artist and date-order of release. Their storage capacity is approximately 25 minutes a side, which is usually 22 minutes too long. And on the opposite wall is where all my CDs sulk, each one capable of storing 74 minutes of audio, and not one of them played since the turn of this century. Why? Because a

symphonies, which are pretty good, some of them prog-rock drum solos, as used by Viet Cong torturers to break the spirit of the enemy. My desktop hard drive and cloud accounts contain too many tracks to keep track of.

## GRATEFUL DEAD

I declare that my motivation for amassing this ludicrous collection of music was that one day it would bring me comfort in my old age, when my body and brain become enfeebled and I feel the need to keep hold of past pleasures while dying. As it turns out, I started playing my collection early, during lockdown, and wished I was dead by the end of day three. The singles were great, but the albums were mostly insufferable.

Which is when I realised that the music album is stone dead, and the nightmare of a lifetime of audio padding is finally over. Then the real truth hit me. The recorded music industry is dead, too. Thanks to Covid-19, there has been an explosion of new creativity. Everyone is now a record producer, anyone can run a broadcast music channel, and that's exactly what everyone and anyone seems to be doing, including me. The spongers, leeches and shysters have been exposed as completely unnecessary, as have most of the agents, publicists and managers. They are no longer able to milk performers in our new world of social distancing, because they have lost their power. It's the remote audience that now has the power, and this audience wants instant gratification, not a load of overhyped, overwrought, overlong, flimflam.

*Jeeni.com* is my final project in a very long career. I'm giving my artists three minutes per track to nail it, because that's what my old hoard tells me is right. And I hope you agree that in order to shine, three minutes is all that anyone should ever need. 📺

Thanks to Covid-19, there has been an explosion of creativity. Everyone is now a record producer, anyone can run a broadcast music channel

duplication was possible. If Miss Florrie Forde wanted to sell a hundred copies of *Hold Your Hand Out You Naughty Boy* to her adoring public, then she had to keep lubricated and trill the bloody thing into a brass horn a hundred times and record it on to wax in real time.

But to me, the beauty of these cylinders is not that each one is a unique recording, but that each one is mercifully short, rotating at 120 revolutions a minute and lasting a meagre two minutes, because that's all a wax cylinder can hold. And so the two-minute pop single was born. At the start

hacker called SoloH went and ripped the source code of something called the Fraunhofer MP3 encoder and spread it all over the internet for free. Thanks to SoloH, I can not only digitise my entire collection of recorded music without any restrictions on playing time, I can access the entire library of everything that has ever been recorded, for ever.

My phone weighs exactly the same as my 78rpm copy of Little Richard's single *Tutti Frutti*, which runs for two minutes, 28 seconds of total perfection. My phone holds 21,417 tracks in MP3 format, some of them complete





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# Science of appliances

**Kay Ewbank** always scoffed at smart kitchen gadgets, but now she's done her knee in she's beginning to see the appeal of an oven that tells her when dinner's ready



**KAY EWBANK**

Software guru and Shopper legend  
letters@computershopper.co.uk

**A FEW WEEKS** ago I managed to sprain my knee, and I've discovered knee sprains are both painful and long lasting. A sprained knee also makes you not want to move around, meaning I had a sudden insight into how old people feel. It's been an interesting experience, because it's made me reconsider various aspects of how technology can help when people lose their mobility, either because of an accident or because they're older and less mobile. The true beneficiaries of smart home technologies aren't the young and trendy, they're the old and creaky.

While I've been confined to my armchair and dependent on asking my family to run round after me, I've spent my time deciding what gadgets I'm going to install around the place, particularly the kitchen. This is a change, as until now I've been unconvinced by many gadgets, seeing them largely as a solution in search of a real problem. How times change; now I'm relying on useless youths as kitchen assistants I'd pay real money to

remember whether you have any avocados left and don't want to move because your knee hurts. Ditto when trying to work out what veg to tell the useless youths to prepare for dinner.

So is a smart fridge with cameras the answer? Maybe, but in reality probably not. There are (expensive) fridges out there with cameras, and more interestingly there are also fridge cams that you can buy to add a camera to your current fridge. The publicity shots look great, but those fridges have one tub of low fat yoghurt, a punnet of strawberries and a salmon fillet. Get a crammed fridge like ours, full of anonymous stuff in dishes, and the cameras struggle because they can't show you what's hiding behind the lettuce or under the plate of leftover dinner. Not worth the cost and hassle; just take some pics using your mobile phone.

## WAVE OF OPTIMISM


Another kitchen gadget that sounds appealing is the smart microwave. These can scan the barcode on food containers to

having similar problems to the fridge cam, but the idea of being able to check from my armchair if the roast chicken looks as though it needs turning down is too good to resist. There are now several cookers on the market that include an oven camera, and most let you both look at the food that's cooking, and adjust the cooking temperature remotely via the app. I reckon this will actually be a feature worth paying a bit extra for. The annoying bit is they don't come with a camera to show whether the carrots are boiling dry on the hob.

## SMELL THE COFFEE

The ability to check whether the carrots are burning or the coffee has finished percolating might be next on the list of smart technologies, however. One French company has received funding from two large kitchen appliance companies for its 'digital nose' powered by artificial intelligence that can learn smells, then compare a new smell to one it already knows (cooked carrots versus those that are burning, for instance).

The interest from appliance manufacturers suggests there's hope for the future when my cooker or coffee machine will be able to tell me when things are going well or not. In fact, the developers say that coffee companies and coffee-machine manufacturers are among the companies who are most interested in the technology and how it can be included in kitchen gadgets in the future.

Overall, the reality is we are still at a point where smart kitchen gadgets aren't that smart. I quite like the idea of the oven with a camera, and an artificial intelligence-controlled digital nose would be wonderful in the future. Until then, I'm just going to have to hobble through, sit on a kitchen chair and snarl – so no change there. 

It's made me reconsider various aspects of how technology can help when people lose their mobility. The true beneficiaries of smart home technologies aren't the young and trendy, they're the old and creaky

have the gadgets available, and when I next replace items around the house, I will choose those with smart aspects.

The first smart gadget in this category is the smart fridge. I've been chortling about these for few years, on the grounds you're going to have to go and actually take the items out of the fridge to eat or cook them anyway, so having the fridge tell you what's in there is a waste of time. Things look rather different when you're trying to do an online supermarket order, can't

see how long the food should be cooked or reheated for, and at what power level. Some also have moisture sensors to prevent your meal drying out, and will let your smartphone know when the food is ready. It's got to be better than the current 'give it a random number of minutes at full power' that most of my 'helpers' seem to think is acceptable.

One smart kitchen gadget I will be choosing if I ever replace my oven is one with a camera. I realise this will probably end up



# RANTS & RAVES

Unscrupulous scalpers are using armies of bots to buy up new tech stock and resell it to consumers at vastly inflated prices. Don't fall for the scam

James Archer

## RANTS



**NVIDIA'S GEFORCE RTX 3080 GPU**, Sony's PlayStation 5 and the Xbox Series X have already sold out, but thousands won't reach the hands of legitimate buyers. Instead, they'll have been snapped up by scalpers and resold elsewhere on the web at vast markups.

The RTX 3080 launch was a particular disaster. It was the full release, not the opening of limited pre-orders, yet the combined efforts of an army of scalpers still wiped out the available stock with the terrifying speed of Ed Sheeran fans on Ticketmaster.

How did so many malicious orders win out? Simple: they used bots, automated software applications written to trawl retailer sites and purchase items instantly. Bots are cheap and smart enough to bypass CAPTCHA protection – not that Nvidia bothered with that – so it was inevitable there would be enough to swamp the RTX 3080 launch like a spilled barrel of depressing grey porridge.

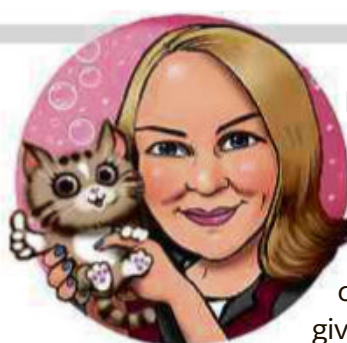
Bots also contributed to Nintendo Switch shortages earlier this year. That makes it even more vexing as to how Nvidia was so unprepared, both in stock volume and anti-bot measures on its store. Some blame, let's be honest, can also be directed at those who play the scalpers' game by agreeing to pay them thousands of pounds over the odds for what are ultimately non-essential leisure devices.

To be clear, however, the real villains of this story are the bot-wielders themselves. Besides the inherent greediness and solipsism that comes with spoiling what would otherwise be a time of excitement for tech enthusiasts, their actions reveal a risible arrogance: claiming mere entrepreneurial intent when exploiting a stock shortage they themselves created, and boasting mastery of a 'market' that wouldn't exist without dirty tricks and a handful of rich suckers.

Since this is *Computer Shopper*, here's some consumer advice. Don't engage with 'resellers', to use the unduly sanitised term, no matter how much you want the latest component, console, iPhone or basketball shoe. Not a single one of these is worth enabling such scam artistry – and especially not just the pride of owning them on day one.

Madeline Bennett

## RAVES



**MY ELDEST DAUGHTER** started secondary school in September. Three weeks in, an entire year group were sent home to self-isolate for two weeks, due to a single confirmed case of coronavirus. A day later, the same happened at another local school – different year group, but 200 more children at home for two weeks.

This is happening to thousands of children up and down the country, and it's a worrying time for parents and kids alike. Most home-schooling is far from replicating the classroom environment, with many students left to learn for themselves from online resources rather than being taught by their teachers.

Add in the fact that only a small portion of work is marked, a lack of feedback provision and kids missing the social interaction with their class, and clearly this scenario isn't sustainable in the long term.

Fortunately, there are some savvy technologists out there working to solve the problem while we await the miracle vaccine.


DnaNudge is one such firm, which has adapted its DNA testing technology to detect coronavirus, and rapidly speed up and scale the testing process.

Its Covid Nudge test might look like a blue, flattened yo-yo from the outside. But on the inside, it houses a chip that can test a patient sample for coronavirus and give the result in just over an hour.

What's more, the device is small enough to be carried around to where it's needed, and can be reused over and over again – although it can only cope with one sample at a time.

The government has bought 5.8 million of these test kits, which should be in use across NHS hospitals any time soon. And at just £28 per test kit, there's no reason why the tests should be limited to hospitals; schools and other organisations that require rapid test results to be able to function would clearly benefit from having several of their own kits to do on-site testing.

It would be wonderful to think that in the not-too-distant future, when the next outbreak happens at my daughter's school, her year group could be called in to take their Covid Nudge tests rather than being sent home for two weeks. Within a couple of days, the whole year group – apart from those students testing positive – could be back in the classroom, confirmed as coronavirus-free.

The technology is there. Let's hope the investment follows. 



# NEED TO KNOW

The biggest stories from the tech world, and what they mean for you

## Apple reveals new iPads and smartwatches

### SAY WHAT?

**APPLE'S AUTUMN LAUNCH** event comes around every year like clockwork, but at 2020's event, entitled 'Time Flies', unusually the firm didn't launch a new generation of iPhones. Instead, it announced two new iPads and two new Apple Watches.

The iPad Air 4 adopts an iPad Pro-style look, a larger 10.9in 2,360x1,640 edge-to-edge Liquid Retina display and, perhaps most interestingly, a USB Type-C port for the first time in a non-iPad Pro.

Touch ID is integrated into power button, there's compatibility with the Magic Keyboard and Apple Pencil, and it runs iPadOS 14.

Other than the headline features, the iPad Air 4 will come in five colours – green, blue, rose gold, black and silver – with Apple's A14 Bionic processor boosting performance significantly.

The model is shipping now, priced from £579.

Apple also revealed a 2020 version of its most popular tablet, the 10.2in iPad.

The headline feature of this 2020 model is that it's now powered by Apple's A12 Bionic chipset, the same processor found in 2018's iPhone XS smartphones. That might sound old-fashioned, especially when the new iPad Air 4 uses the A14 Bionic, but Apple says the iPad 10.2in (2020) is 40% faster than last year's model in CPU processing, with a 50% boost in graphics performance.

The iPad 10.2in (2020) also ditches the Lightning cable and makes the move to USB Type-C for charging and data transfer. Pricing starts from £329, and the new models are available now.

Apple also launched a low-cost wearable named the Apple Watch SE at the event. This represents the first time that Apple has launched a cheaper smartwatch rather than selling an older model alongside the



latest model at a reduced price. It's available to buy now, with prices starting at £279.

The new budget-friendly Watch SE has essentially the same design as the flagship and uses Apple's S5 chip, which it claims is twice as fast as the Watch 3 (still available from £200).

As with the regular Apple Watch, you can get the Apple Watch SE in two different sizes (40mm or 44mm), and in either GPS-only or cellular models with the larger better-equipped models.

Alongside the cheaper SE, Apple unveiled its Watch Series 6, which is mainly another iterative update.

Headlining the list of new features is blood oxygen monitoring. The Apple Watch Series 6 will bounce infrared waves off the blood vessels in your wrist, determining the colour of your blood in order to work out how oxygenated it is.

Inside the Apple Watch Series 6 is a new S6 System-in-a-Package processor. Based on the Apple A13 processor in the iPhone 11, the S6 is a dual-core chip that promises up to 20% faster performance than the last generation of processor. Battery life will stay the same, at 18 hours, although charging is faster, taking just one-and-a-half hours from empty.

The Watch Series 6 is on sale now, with two models to choose from in two different sizes, 40mm and 44mm. The GPS-only 40mm model will set you back £379, the GPS/cellular 40mm model is £479, while the larger 44mm models cost £409 and £509 respectively.

Apple is also introducing a vast number of new watch bands, including a new Solo Loop and Braided Solo Loop range without clasps or buckles (available in plastic and fabric, respectively). The new Leather Link also loses the clasp, and traditionalists will be pleased to see that there are more colours available for the Nike Sports bands.

### SAY WHAT?

**THE IPAD AIR 4** is more powerful than the recent iPad Pro updates released earlier this year. This is the first glimpse of Apple's 5nm processor and, if Apple's claims are to be believed, it will deliver a big boost to both performance and efficiency.

The new chip packs in 11.8 billion transistors, six CPU cores (with four high-efficiency cores and two performance cores), and a quad-core GPU that's 60% faster than in the previous iPad Air. It also incorporates Apple's Neural Engine and the latest Apple ISP for improved photo- and video-capture capabilities.

The introduction of that new edge-to-edge display also means there's no room for the front bezel home button any more. Instead of implementing the Face ID system found on Apple's iPhones, however, the iPad Air will keep Touch ID but move it instead to the power button in the edge in the corner.

In a surprise move, Apple is also making a Magic Keyboard available for the iPad Air 4, complete with the same Scrabble-tile keys and integrated touchpad as the Magic Keyboard for iPad Pro.

Apple also introduced iPadOS 14, which both of the new models will run. This brings a handful of improvements including handwriting and shape recognition, with a smart selection feature that distinguishes between handwritten notes and doodles. The new Scribble feature

also allows you to use the Apple Pencil in any text field, and annotate notes over a variety of documents.

Both new Apple Watches, meanwhile, come with watchOS 7, which implements the new Sleep app for sleep tracking, alongside vastly improved VO2 max measurement software and even a new hand-washing monitor to make sure you're not skimping.

In addition, watchOS 7 introduces a vast number of new watch faces. The GMT face displays multiple different timezones, while the Chronograph Pro face acts like a traditional watch face with a built-in Tachymeter and other smaller faces. There are also purely decorative faces, including new Stripes patterns, an Artist collection and even on-watch Memoji.

Both models also offer Family Setup, a standout new feature that lets both younger and older members of your family take advantage of features such as emergency international calling and Emergency SOS (which alerts emergency contacts automatically in the event the wearable detects a hard fall). Interestingly, these family members will also be able to set up their Apple Watch without having their own iPhone, the first time this has ever been possible.

At £270, we expect the Watch SE will sell in droves, particularly since it adds the ECG functionality that's not offered by the Apple Watch 3. In essence it's an Apple Watch 4, repackaged with appealing new features.

“Apple's 5nm processor will deliver a big boost to both performance and efficiency”



## FROM THE LAB

### Microsoft retrieves underwater data centre after two years

**MICROSOFT HAS RETRIEVED** a data centre from the ocean floor, just off the coast of Orkney, Scotland, and early signs show that the project was successful.

Of the 864 servers onboard, Microsoft reports that only eight failed, which is an eighth of the failure rate of a typical land-based data centre.

A team from Microsoft sank the cylindrical storage container, called 'project Natick', in 2018. It was loaded with 12 server racks and ocean water kept the servers cool. The container was also sealed and filled with nitrogen, which is not as corrosive to computer equipment as oxygen.

The research team are now conducting tests on the data centre to see what they can learn from the experiment and how it could help solve environmental problems raised by conventional data centres.

"Computers are not designed to work in the environment we humans operate," said Spencer Fowers, principal researcher for project Natick.

"Things like oxygen, moisture in the air, that is really bad for computers, it causes corrosion on the components.

"You also get temperature fluctuations. The heat from night to day, summer to winter, can cause components to fail so we had this theory: if we're in a stable environment, we're in this cylinder, we've taken all the oxygen out, controlled the humidity, no one's walking around, bumping into things, causing additional failures, we'd see better reliability."



The concept of an underwater data centre first came up at Microsoft's 2014 'ThinkWeek' as a way to provide fast cloud services to coastal populations. With more than half of the world's population living within 120 miles of the coast, localised hubs would give data a shorter distance to travel, leading to smoother, faster services.

Once it was hauled out of the sea, the container was cleaned and air samples were retrieved. The data centre was then loaded on to a truck and driven to a facility in the north of Scotland, where the server racks were slid out so Fowers and his team could perform health checks and collect components to send to Microsoft for analysis.

Among the components boxed up and sent were the failed servers and related cables. The researchers think this hardware will help them to understand why the servers in the underwater data centre are seemingly more reliable than those on land.

## SOUND BYTES

**“We're still working on the same games we were yesterday, made by the same studios we've worked with for years, and those games will be published by us”**

Bethesda SVP **Pete Hines** reassures gamers on the news that Microsoft is buying the Doom creator for \$7.5bn

**“We would like to thank our customers for giving M&S such a big welcome and sincere apologies to any customers having to wait a bit longer”**

Ocado was forced to apologise on the first day of its tie-up with Marks and Spencer after online customer orders were cancelled

**“ARM will remain headquartered in Cambridge”**

In the wake of its \$40bn purchase of ARM, Nvidia CEO **Jensen Huang** says it will build a world-class AI research facility in the UK

**“We are using Amazon's deep expertise in AI and machine learning to offer customers a new way to discover, adopt, and maintain personalised wellness habits”**

Dr **Maulik Majmudar**, Amazon Halo's principal medical officer, talks up the firm's first fitness tracker, which will also eavesdrop on its owner to assess if they are happy or sad

### Google aims to go carbon-free by 2030

**GOOGLE HAS ANNOUNCED** it aims to run on carbon-free energy by 2030.

CEO Sundar Pichai called the carbon-free target a 'stretch goal'. He explained it would force Google to move beyond offsetting its carbon emissions, and require technological and political breakthroughs.

"The problem is so immense, many of us need to lead the way and show solutions," Pichai said.

"We're one small player in this, but we can set an example."

Last year, wind, solar and other renewable energy sources accounted for 61% of Google's electricity usage. Carbon-free sources fulfilled 96% of hourly power needs at Google's Oklahoma data centre, while its gas-reliant Singapore location had only 3% carbon-free power.

Pichai says he's optimistic Google can bridge that gap by using emerging sources such as geothermal reservoirs, batteries to store solar power overnight and managing its overall power needs better.

"To plan 24/7 hourly being carbon-free in our data centres and campuses around the world, we see an enormous logistics challenge, which

is why we've been hard at work modelling the last year how to get there," Pichai said.

"And we feel confident we can get there by 2030."

To reach its goals, the tech giant is investing in technologies to help its partners and people make sustainable choices. Google is committed to helping 500+ cities and local governments globally reduce 1 gigaton of carbon emissions annually by 2030.

Google is also working with a network of organisations on a science-based approach to reforestation and restoration. It has launched a €10 million Google.org Impact Challenge in Europe to support sustainability ideas and projects.

Google estimates its commitment to carbon-free energy will generate over 20,000 new jobs by 2025.

"We're optimistic that by harnessing new technologies, investing in the right infrastructure and tools, and empowering partners, non-profits and people, this can be the most decisive decade for climate action yet. We're proud to do our part, and to help move the world closer to a carbon-free future for all," Pichai added.





# THE LOWDOWN

## Survive life during lockdown

With new restrictions being imposed the coronavirus is still affecting all our lives, and it's possible that further measures may be introduced as we approach the colder months.

Here are some of the most useful web tools for adjusting to the 'new normal'

### FIND THE NEAREST PUBLIC TOILET

Many shops, pubs and restaurants have reopened, but many public toilets haven't, either for safety reasons or because staff aren't available to clean and maintain them. This poses a problem with a capital pee for anyone caught short while out enjoying their post-lockdown freedom, but help is at hand from Lockdown Loo ([www.lockdownloo.com](http://www.lockdownloo.com)). This resource shows you the location of thousands of open toilets across the UK, including train stations, cafés, shopping centres, supermarkets and parks.



↑ Lockdown Loo shows you the location of toilets open to the public around the UK

For your convenience, many entries include details of opening times, cleanliness and disabled access, with options to submit your own loo-cations and correct inaccurate information (the site rejects duplicates and silly suggestions such as bushes).

With more than 5,000 toilets currently pinpointed, Lockdown Loo can be a bit fiddly to use on your phone, so its makers recommend opening its map in Google Maps for easier navigation, by tapping the square in the top-right corner.

Alternatively, you could install Toilet Finder for Android or iOS, although its results aren't guaranteed to be open.

### AVOID LONG QUEUES AT THE SHOPS

Hour-long waits to get into supermarkets have thankfully gone, but with more people now visiting shops that are open, you may find yourself queueing outside more often than

➡ Google's 'Popular times' data helps you avoid having to queue outside shops

you'd like. One way to avoid the socially distanced crowds is using Google's 'Popular times' data.

Search for the store you plan to visit, then scroll down the information panel on the right (at the top on mobile) to the 'Popular times' section. Here you'll see a bar chart showing the busiest times to visit the shop throughout the day and week, accompanied by summaries such as 'Usually as busy as it gets', and details of how much time people typically spend there.

For bigger stores, you may also see live data sourced (anonymously) from Google users who are shopping there right now. Look for the pink bar and if the status is 'Not too busy' then you probably won't have to queue. 'Popular times' data can also be viewed in Google Maps, and though it isn't available for all shops, it's certainly worth checking.

Additionally, there's a free app called Supermarket Check-in, which predicts queue times and even stock levels for stores in your area. However, its information relies on other users 'checking in' to those places.



### GET A SEAT ON PUBLIC TRANSPORT

During lockdown, buses and trains were virtually empty, but now that restrictions have been lifted, they're getting busy again. To ensure you remain safely socially distanced and preferably get a seat on your journey, you can check the 'crowdedness level' in the Google Maps app.

Search for public-transport directions, select a bus or train route and look for predictions such as 'Usually standing room only'. This feature is only available in certain UK cities, and initially used data from before the coronavirus struck, so you might not see updated info yet. However, you can still check



↑ National Rail's Alert Me tool warns you about busy train services via Facebook Messenger



station crowdedness using the 'Popular times' data mentioned in the previous tip.

To combat overcrowding, National Rail is now alerting passengers to busy train services to encourage travel at quieter times. Look for a red or yellow warning triangle when you check your journey on the National Rail website or app, and sign up for its Alert Me tool to receive information about crowded trains and stations, as well as delays and disruptions, via Facebook Messenger (WhatsApp alerts are coming soon).

Additionally, Trainline has added a Crowd Alerts feature to its mobile app that tells you how busy train carriages are.

## PICK UP A PINT FROM THE PUB

If you're apprehensive about returning to your local pub, whether due to health concerns or because of the strict new rules, why not pick up a pint to drink at home?

Takeaway Pints provides a map of hostelrys that are offering a collection service for draught and bottled beer and cider, wine, cocktails, hot drinks and food. Although originally London-centric, it now covers counties across Britain, from Aberdeenshire to Yorkshire, and lets you submit details of pubs it has missed.



↑ If you're unable or unwilling to sit in the pub, pick up a takeaway pint instead

To find out which pubs are now open in your area, you can either check their websites and social-media pages or again turn to Google Maps. Search for 'pubs near me' and the map will pinpoint nearby venues and tell you whether they're serving again or are still temporarily closed.

Similarly, you can find cafés in your area by tapping the Coffee option at the top of the Maps app, then choosing 'Open now', but Google does warn that "Hours or services may differ due to Covid-19".

## PLAN YOUR POST-LOCKDOWN HOLIDAY

The coronavirus put paid to most of our holidays this year, but if you're desperate to get away now that some of us are able to move again, consider a staycation. 101 UK Holidays offers hand-picked suggestions for post-lockdown breaks in Blighty, such as exploring the Jurassic coast, hiking the Lake



↑ Learn which lockdown restrictions are still in place in countries across Europe

District and renting a shepherd's hut in Devon, while Cool Camping provides a guide to Covid-19-secure camping.

If you'd prefer to holiday in Europe, Re-open EU tells you the current situation in different countries, including travel regulations, health and safety regulations, and whether shops, bars, restaurants, beaches and attractions are open.

Tinned vegetables, soup and fruit, pasta and rice, tea and coffee, and toiletries are especially welcome, or you can make a financial donation online.

## CHECK COVID-19 INFECTIONS IN YOUR AREA

The government is reportedly planning to launch a web dashboard that displays

## DONATE TO LOCAL FOOD BANKS

One upside to lockdown life was a reduction in food waste, as housebound Brits became more creative with their cooking and more casual about use-by dates. The downside was that food banks received less support, with many supermarkets removing their donation boxes.

Now that shops and cupboards are fully stocked again, you may want to consider helping the needy by sharing your excess supplies. You can find food banks in your area via the Trussell Trust website, which provides contact details for more than 1,200 centres across the UK.



↑ Get an overview of infections in your area using the BBC tool

coronavirus test results by neighbourhood and possibly even by street and postcode, to help identify local outbreaks. In the meantime (and we won't hold our breath), you can get general

figures for infections in your area via the BBC's Coronavirus UK page ([tinyurl.com/394news1](https://www.bbc.com/news/health-56948481)).

Search for a UK postcode, English, Welsh or Northern Irish council or Scottish health board to view the number of confirmed Covid-19 cases and deaths, and how the death rate compares to the rest of the country. 📊



← Help the less fortunate by donating your excess supplies to a food bank



# REVIEWS

YOUR TRUSTED GUIDE TO WHAT'S NEW



ANDROID 10 TABLET

## SAMSUNG Galaxy Tab S7+

COMPUTER  
SHOPPER  
BEST BUY



£799 • From [www.samsung.com](http://www.samsung.com)

### VERDICT

The Galaxy Tab S7+ is gunning for the iPad Pro, and scores a few direct hits





**ANDROID TABLET MAKERS** have struggled for years to topple the unrelenting might of Apple's ever-popular iPad line-up. From Acer to Huawei, many Android alternatives aren't much more than characterless iPad copycats, and they've failed to make even the smallest dent on Apple's sky-high sales so far.

Things might be looking up for Android, however, with the arrival of the Samsung Galaxy Tab S7+. Launching alongside the Galaxy Note 20, Galaxy Watch 3 (page 40) and Galaxy Buds Live, Samsung's latest high-end Android tablet is quite impressive, and even manages to beat Apple to the line when it comes to 5G connectivity.

Both this and its smaller, cheaper version, the Galaxy Tab S7, are also clearly intended as direct competitors to the recently refreshed iPad Pro (Shopper 393). The S7+ has a 12.4in display, and the regular S7 has an 11in screen.

## SPENDING POWER

We reviewed the Samsung Galaxy Tab S7+, which not only has a larger screen but also

has a bigger 10,090mAh battery than the regular Tab S7 and is the only model with the potential for 5G connectivity, something the iPad Pro doesn't currently offer.

Elsewhere, the Tab S7+ has a number of other advantages compared to the iPad. It comes with a bundled stylus, and the tablet can also be used in DeX mode, a desktop-like user interface that transforms the Tab S7+ into a makeshift laptop.

The Wi-Fi-only version of the Tab S7+ costs £799 and comes with 128GB of storage, which can be expanded via microSD up to a further 1TB. The 5G LTE variant costs £999.

If you aren't in a 5G zone, then you might want to go for the 4G variant of the 11in Tab S7, which costs £719. The absolute minimum you can spend on one of Samsung's newest tablets is £619, which nets you the Wi-Fi-only 11in Tab S7.

Compare these prices with the iPad Pro, and Samsung finds itself in a remarkably strong position. The entry-level 11in iPad Pro starts at £769, while the 12.9in variant starts

at £969. Neither Apple tablets come with 5G, with the 4G LTE versions costing £919 and £1,119 respectively, neither has storage expansion, and neither includes a stylus in the box as the Tab S7 and Tab S7+ do.

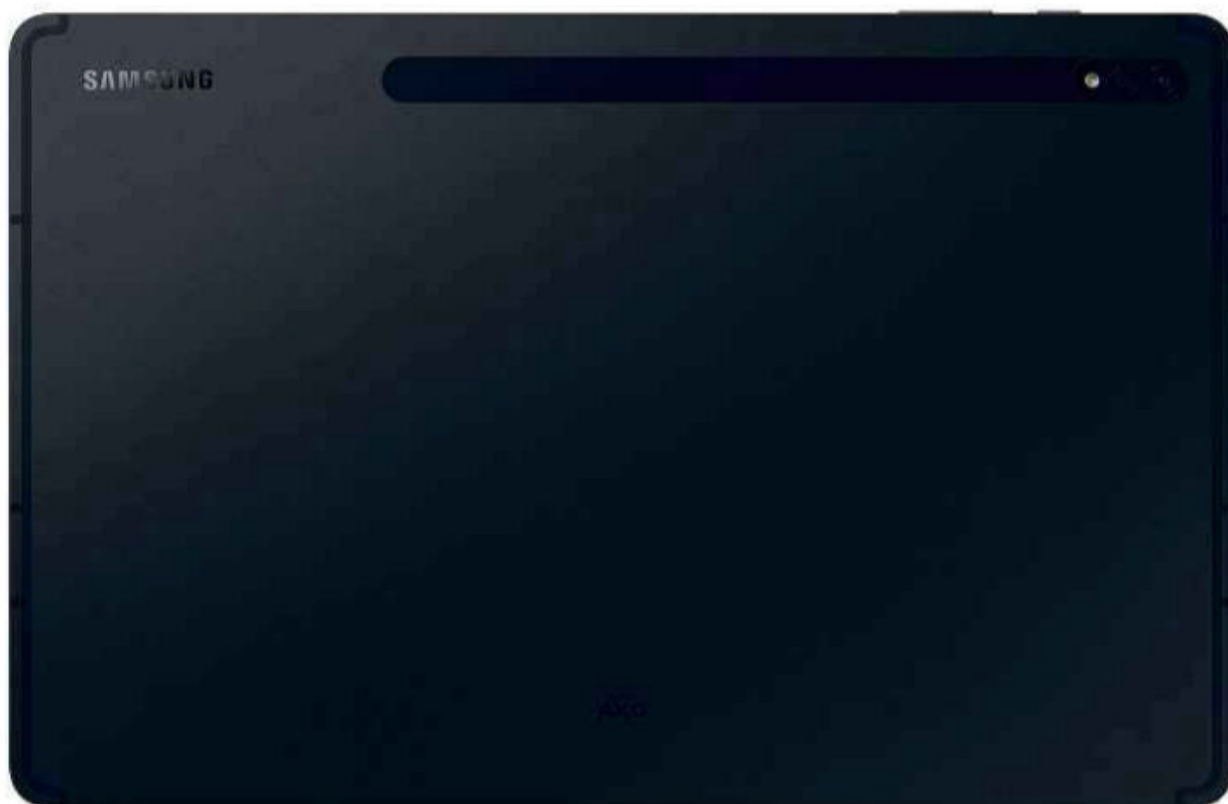
## CHOOSE A SIDE

As for looks, the design hasn't changed much for the Tab S7+ since the Tab S6. It has a large screen, skinny bezels, flat sides and feels surprisingly lightweight, despite its rather monstrous physical dimensions of 285x185x5.7mm. The Tab S7+ can be picked up in a choice of three colours: mystic bronze, mystic black and mystic silver.

There is, however, one quite visible difference between this model and the Tab S6. The selfie camera, which can also be used for unlocking with your face, is now situated on one of the tablet's long edges. This makes sense when you consider that Samsung is trying to position the Tab S7+ as a quasi-laptop for working on the go.

Speaking of which, if you're hoping to use the Tab S7+ like a conventional laptop, then there's also an optional two-part keyboard cover available to buy. The first part comprises a cover that magnetically snaps to the back of the tablet. This has an integrated kickstand and a smooth hinge that allows you to angle the tablet up to almost 180°, as well as a handy slot to neatly store the S Pen stylus. The keyboard part simply attaches to the magnetic three-pin connector on the tablet's bottom edge, it includes a touchpad, and it doubles up as a protective cover for the screen.

It's a very comfortable keyboard to type on, each key having a decent amount of travel and good feedback. The spacing between each letter is just right, too. You're probably not going to get up to your full touch-typing speed on it straight away, but you won't be making loads of mistakes from the get-go either. You have to pay £190 for this new keyboard, which is a bit disappointing.





FLEXIBLE WORKING

What you do get for free, however, is DeX mode, a desktop-style interface that's designed to work with a keyboard and mouse and can even be displayed on an external monitor. The latter can now be done wirelessly if you happen to have a TV or monitor that supports screen-mirroring.

DeX mode automatically activates when you connect the keyboard cover, or it can be manually enabled by pulling down the notification drawer and tapping the DeX icon.

In DeX mode, you can use your tablet (almost) like a fully fledged laptop, with the ability to open multiple windows at once, drag and drop, and right-click for context-sensitive options. We liked being able to access an onscreen keyboard easily with a simple tap of the taskbar icon, and we were particularly impressed with how DeX managed incoming notifications: they neatly appear in the bottom-right corner of the screen, just like they do in Windows 10.

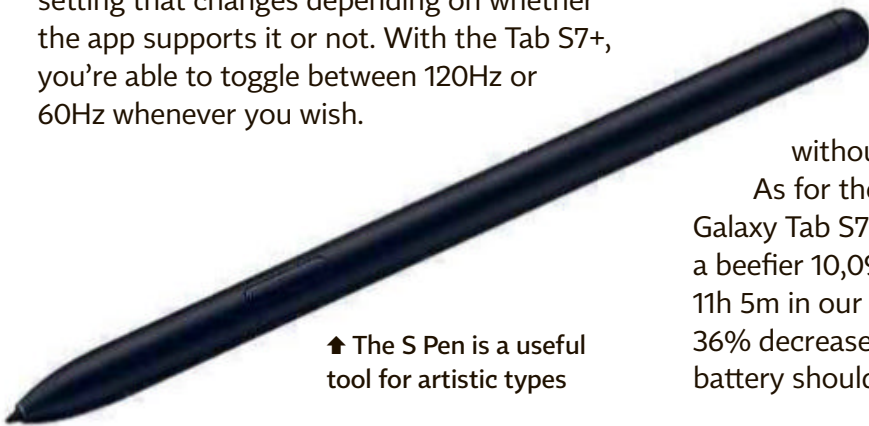
The Tab S7+ isn't just a work machine, however, as it's also one of the first mobile devices to support Microsoft's Project xCloud game-streaming service. The service isn't live just yet so we haven't been able to test it out for the purposes of this review, but provided that you have an Xbox Game Pass Ultimate subscription (£11 per month) and a strong enough internet connection, you'll be able to stream and play over 100 Xbox games on the tablet.

As for the included S Pen stylus, not much has changed when it comes to the design, but the writing latency has been improved thanks to the new high-refresh screen. Pressure and tilt sensitivity work well, so it should be a useful tool for the more artistically inclined. It's still bundled at no extra cost, too, which is nice when the 2nd-gen Apple Pencil costs an extra £119 to add to the already pricey iPad Pro.

FIXED RATES

Because of the size differences, the screen resolution differs slightly between the 11in Tab S7 and 12.4in Tab S7+. In a first for Samsung, both tablets use a 120Hz, HDR10+ 'Dynamic AMOLED' panel, with the regular Tab S7 having a resolution of 2,560x1,600. On the Tab S7+ you'll be interacting with a 2,800x1,753 display with a pixel density of 274ppi (beating the 12.9in iPad Pro's 265ppi).

It's worth mentioning that the screen on the 2020 iPad Pro is also technically capable of reaching up to 120Hz, but it's an automatic setting that changes depending on whether the app supports it or not. With the Tab S7+, you're able to toggle between 120Hz or 60Hz whenever you wish.



↑ The S Pen is a useful tool for artistic types



The Samsung Galaxy Tab S7+ gives you two colour profiles to choose from: Natural and Vivid. Both deliver delightfully rich, bold colours, no matter the viewing angle. In testing, we found that the most colour-accurate of the two (compared with sRGB) was the Natural mode, with a measured average delta-E of 2 (the lower the better). In this mode, the Tab S7+ covered 93.5% of the sRGB colour space, with a total volume of 94.5%, and brightness peaked at 367cd/m<sup>2</sup>.

DONE IN A SNAP

Powering the Tab S7+ is the Qualcomm Snapdragon 865+, which is strange considering Samsung could have used its own Exynos 990 chipset and saved a few quid in the manufacturing process. Still, this is a welcome move on Samsung's part, since the Snapdragon 865+ is actually a slightly more powerful SoC.

And it performed well in our tests. In the Geekbench 5 CPU benchmark, the Tab S7+ achieved a single-core result of 965 and a multicore score of 2,814. The iPad Pro is faster, especially for multitasking, but the Tab S7+'s single-core power isn't far behind despite it costing much less cash.

With the tablet running Android you're slightly more restricted with the type of apps you can run, but whatever you do decide to throw at it, the Tab S7+ will just about shrug off anything without breaking a sweat.

As for the rest of the internals, the Galaxy Tab S7+ comes with 8GB of RAM and a beefier 10,090mAh battery. This lasted 11h 5m in our video rundown test, which is a 36% decrease on the Tab S6's 15h 6m, but the battery should last a full working day without

needing to be charged. If you're away from a wall socket for a longer stretch of time, you can squeeze out an extra 22% of juice if you dial the screen refresh rate down to 60Hz.

Both Tab S7 models also come with a microSD slot, which can take cards up to 1TB in capacity, as well as 13- and 5-megapixel (wide-angle) cameras and an 8-megapixel selfie snapper. These cameras all work well in a pinch, and both tablets support Wi-Fi 6 as well as the aforementioned 5G capability.

SEVENTH HEAVEN

In the end, whichever variant of the Samsung Galaxy Tab S7 you go for, you're going to get an absolute belter of a tablet. The keyboard cover is nice (if you buy one), the tablet itself is lovely, DeX mode works well, and the stylus is included in the box at no extra cost.

Pair all that with the fastest Qualcomm processor to date, a slick 120Hz screen and the potential for 5G connectivity, and the Tab S7+ is a great tablet for everything from working on Word documents to watching Netflix. And the price, which is considerably less than the equivalent Apple iPad Pro, makes for an exceedingly tempting purchase.

Nathan Spendelow

SPECIFICATIONS

- PROCESSOR Octa-core 3.1GHz Qualcomm Snapdragon 865+
- SCREEN SIZE 12.4in
- SCREEN RESOLUTION 2,800x1,753
- REAR CAMERAS 13 megapixels, 5 megapixels
- STORAGE 128GB
- WIRELESS DATA 4G and 5G (optional)
- NFC No
- DIMENSIONS 285x185x5.7mm
- WEIGHT 575g
- OPERATING SYSTEM Android 10
- WARRANTY One year
- RTB
- DETAILS [www.samsung.com](http://www.samsung.com)
- PART CODE SM-T970

Battery life

11h 5m

0% -50 Reference +50 +100

See page 88 for performance details





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## ALL-IN-ONE WINDOWS PC

# ACER Aspire C 24 (2020)

COMPUTER  
SHOPPER  
BEST BUY



£699 • From [www.currys.co.uk](http://www.currys.co.uk)

### VERDICT

A host of upgrades make this new version of Acer's affordable AIO better by far

**ALL-IN-ONE PCs** have quietly become one of the better options for those needing a complete desktop setup for minimal money; building your own PC will likely always be the cheapest route, but for those short on time or technical knowledge, getting a brand-new system with a Full HD display and even the key components thrown in for less than £500 can be a great deal.

The recently redesigned Acer Aspire C 24 is a fitting example, starting at just £479, but the £699 model we were sent for testing sounds like a bargain as well, considering it includes a mid-range Intel Core i5-1035G1 processor from Intel's latest CPU family, as well as a huge 1TB SSD.

### STAND STILL

This is all stashed behind a 23.8in, 1,920x1,080 IPS screen, which itself is surrounded by pleasantly slim bezels. Much like last year's iteration of the Aspire C 24 (*Shopper 380*), the whole thing is much slimmer and more modern-looking than the price might suggest, and although it's primarily made from plastic, there isn't a whole lot of creaking or flexing. It's simply a stylish, well-built machine.

One potential exception is the stand. It's not weak and wobbly, but it holds the display quite low to the desk, which from an ergonomics perspective isn't great for taller users. The screen can tilt upwards, which helps a bit, but there's no height or swivel adjustment whatsoever.

Perhaps the biggest design change from the previous model is that the webcam is

now integrated within the top bezel; previously, the camera was a bundled but physically separate module that connected via USB and stuck on to the top of the screen with magnets. This had its benefits, as leaving it unplugged would guarantee privacy when not in use, and it allowed the bezel to be slightly slimmer than it is here, but we like this change, too. It's certainly more convenient to not have to dig the camera module out of a drawer whenever someone wants to call, and the camera itself is pretty small, so that top border doesn't become thick to the point of ugliness.

It also saves you the usage of a USB port. The Aspire C 24 has four of these on the rear, all USB3 – a notable upgrade on the 2019 model's USB2 ports – along with an SD card slot, a 3.5mm audio jack, one HDMI output (should you wish to add a second monitor) and an Ethernet port. Bluetooth and 802.11ac Wi-Fi are also built-in, and while it would be preferable for the newer 802.11ax standard to be supported instead, it's fine as most routers only support 802.11ac anyway.

### RAT RACE

On one level this connectivity could be called fairly basic, even

with the switch from USB2 to USB3; four USB ports is, indeed, not a lot for a desktop PC, even an all-in-one. That said, the HDMI output and SD card slot are nice bonuses, and you can save further on USB usage via wireless peripherals – including, as luck would have it, the mouse and keyboard that come in the box.

Normally we'd advise ditching these and replacing them with something more comfortable, more tactile and just all-round better, as bundled peripherals are almost always terrible. Fortunately, Acer has reworked the new Aspire C 24's mouse and keyboard as well as the PC itself. They're both just as plasticky as last year's versions, but the mouse now has a nicely textured grip section, while the keyboard adopts a slimmer, squarer and more modern design. It's been a while since we used the 2019 model's keyboard, but we're convinced that this updated keyboard feels sharper and less mushy to type on. At the very least, these peripherals will tide you over until you feel like upgrading to a more ergonomic mouse or perhaps a mechanical keyboard.

### QUICK FIX

An even better upgrade, however, comes to the storage. The 2019 Aspire C 24 we originally tested was also £699, and only







included a painfully slow hard disk, which didn't just slow down file transfers but also made Windows feel sluggish and frustrating to use in general.

For the exact same money, this new model keeps the same 1TB capacity – more than enough for most users – but drastically boosts speed with an NVMe SSD. It's brilliantly fast, recording a sequential read speed of 2,793MB/s and a sequential write speed of 2,546MB/s, and completely eliminates the slowdown that plagued the previous C 24. The fact that Acer has found a way to drop in such a speedy, high-capacity SSD without adding a single penny to the price is by far the most impressive thing about this AIO.

### COLOUR CORRECT

The improvements don't end there, either. While its predecessor had a good enough display for the price, the new C 24's panel performs even better, particularly with its higher peak brightness of 325cd/m<sup>2</sup> and an excellent average delta-E of 1.1. This means that while its sRGB gamut coverage of 87.7% falls short of the most vibrant standards, the colours it can represent will be accurate to almost professional standards.

In terms of size, 23.8in is probably the smallest we'd recommend for a monitor, but both this spec and the resolution are a decent enough pairing. The C 24 was never going to have a 1440p or higher resolution at this price, and while a 27in screen would have been slightly more comfortable when juggling multiple windows, it does help

ensure that the resolution isn't too stretched out, which would make everything look more distractingly pixellated.

Using IPS tech was also a good choice, as it produces wider viewing angles than TN or VA screens, something you might come to appreciate given the lack of pivot adjustment.

At 966:1, contrast ratio takes a small step back from the old model's 1,008:1, but you'd struggle to see the difference unless viewing an extremely dark image. We'd rather have the higher brightness, anyway.

### GAME'S OFF

There are core performance gains, too, albeit in a somewhat odd manner. The new C 24 scored 120 in our image test, 67 in the video test and 61 in the multitasking test, so while it was much better for single-core performance than the old C 24 and also beat it in multitasking, it dropped points in the video section, resulting in its calculated overall score of 73 being just two points higher than that of the model it replaces.

Still, that shouldn't trouble you if you're only running applications like Word and Chrome. The bump in single-core power will actually help out for basic computing like this, and again, almost everything will feel a lot faster on the new SSD.

Just don't try gaming on this PC, unless you're willing to settle for very basic titles and settings. Using Ultra quality in Dirt Showdown at native 1080p, Intel's integrated graphics could only produce a sputtering 14fps; a playable 37fps was possible with Low quality and dropping from 4x MSAA to 2x, but even that doesn't bode well for more modern games.

### REFINED TASTES

As an easy-to-use home office PC, however, there's not much that can compete with the Acer Aspire C 24 – at least not without dropping a lot more cash. Acer's tweaks to the connectivity and peripherals enhance the basic usability of what was already a good-quality AIO, while the display gets even better, and the SSD proves an outright revelation.

If there's one thing not to like, it's the stand: we wish it was either taller by default, or more adjustable. Otherwise, this is one of the most successful redesigns in recent memory. We don't have a 'Most Improved' award, so the Aspire C 24 will have to settle for a Best Buy instead.

*James Archer*

### SPECIFICATIONS

**PROCESSOR** Quad-core 1GHz Intel Core i5-1035G1 • **RAM** 8GB DDR4 • **FRONT USB PORTS** None • **REAR USB PORTS** 4x USB3  
• **TOTAL STORAGE** 1TB SSD • **GRAPHICS ADAPTOR** Intel UHD Graphics G1 • **DISPLAY** 23.8in, 1,920x1,080 IPS • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** [www.acer.com](http://www.acer.com) • **PART CODE** C24-963 D

Windows overall	73
Multitasking	61
Dirt Showdown	FAIL
Metro: Last Light	FAIL

0% -50 Reference +50 +100  
See page 88 for performance details



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BAREBONES PC

ASUS Mini PC PN50

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VERDICT

Quality connectivity, processing power and a neat and tidy design makes for a small yet superb PC



**BAREBONES PC SYSTEMS** don't come much smaller – or much better – than the PN50. Measuring 49x115x155mm, it's so tiny that even the included VESA mounting plate outsizes it by a couple of millimetres, and an assortment of fully up-to-date internals make it hard to beat on performance or value.

As with any barebones system, you'll need to provide and install your own RAM, storage and operating system – potentially bumping up the price by £200 or more – but for £320, what you get pre-installed isn't half bad. This includes one of AMD's new Ryzen 4000 chips, the hexa-core Ryzen 5 4500U, as well as built-in Wi-Fi 6 and Bluetooth 5.0 connectivity.

A FITTING START

What's more, adding your own parts is a cinch. The base comes off via four simple screws, and the two SO-DIMM memory slots, single M.2 slot and single 2.5in drive tray are immediately accessible, with no awkward overlapping layout quirks. Having room for both a full-size, 2280-model M.2 SSD and a 2.5in SATA drive is a quality in itself, especially since the recent Zotac ZBOX CA621 Nano (*Shopper 392*) could only hold smaller (and much rarer) 2242 M.2 SSDs.

We also like how 2.5in drives are mounted: you affix them to the base, rather than inside the main case, so when you replace the base, the drive's power and data ports slide on to the protruding connectors positioned above the circuit board. This removes the need for 2.5in mounting

brackets to be positioned within the case, where they'd likely get in the way of RAM or M.2 installation due to the confined space.

Back on the outside, Asus has gone for a boxier, but cleaner and sharper design than its VivoMini and PB series mini PCs. It's simple and unassuming, as a mini PC should be, and both the front and back are littered with connectivity.

Truth be told we'd have appreciated more than three full-size USB ports, which come in the form of one USB3 at the front and two USB3s at the back, though this is balanced out

score of 29 by the ZBOX CA621 Nano, despite the PN50 only costing £36 more.

Active CPU cooling helps, compared to the ZBOX CA621 Nano's purely passive cooling, and while this prevents the same silent running, the PN50's dinky fan isn't too loud.

The PN50's integrated graphics, AMD Radeon Graphics 384SP, are also far superior to the ZBOX's. For one thing, we could actually launch *Dirt Showdown* without crashing, and managed to average 30fps at 1,920x1,080 with Ultra settings enabled. Drop to 1,280x720 and High settings, and that leaps to 73fps.

You'll need to provide your own RAM, storage and OS, but for £320, what you get pre-installed isn't half bad

by the inclusion of two faster USB Type-C ports. Both of these can also carry a DisplayPort signal, adding extra video output options on top of the HDMI and standard DisplayPort outputs on the rear.

It's great that the latest Wi-Fi 6 standard is supported, although a Gigabit Ethernet port is also available for a wired connection, and a combined mic and headset jack on the front handles sound duties. Lastly, there's a microSD slot on the front – potentially convenient, though a full-size SD card would be more ideal – and, unusually, an IR receiver, so you can navigate with a remote control.

That's perfect for using the PN50 as a home entertainment PC, though as with the RAM and storage, you'd need to buy a remote yourself.

More demanding 3D games won't run well – *Metro: Last Light Redux* only coughed its way to 10fps at 1080p – but for light living-room gaming, the PN50 is perfectly adequate.

**SMALL FORTUNE**

CPU power is the real star, however, and the PN50 is the first cheap mini PC we've tested in a long time that would work particularly well as an everyday PC and not just an occasional media player or utterly basic space-saver. Thoroughly modern connectivity – both wired and wireless – only help this cause, and the two different storage slots leave scope for future upgrades. It wouldn't make much sense to call any barebones PC a complete package, but the PN50 can certainly become one with relative ease, and for impressively little cash.

*James Archer*



TASK MASTER

We tested the PN50 with 8GB of DDR4 memory and a 1TB SSD with Windows 10 Home installed. Its Ryzen 4500U lacks the Simultaneous Multithreading feature of its desktop 3000 series cousins, and so couldn't leverage another six virtual threads, but it didn't really need to: in our 4K benchmarks it scored 137 in the image test, 109 in the video test, 128 in the multitasking test and 123 overall. That's more than four times better than the paltry overall

**SPECIFICATIONS**

**PROCESSOR** Hexa-core 2.3GHz AMD Ryzen 5 4500U • **RAM** None (supports up to 64GB SO-DIMM DDR4) • **FRONT USB PORTS** 1x USB3, 1x USB Type-C • **REAR USB PORTS** 2x USB3, 1x USB Type-C • **STORAGE** None • **GRAPHICS ADAPTOR** AMD Radeon Graphics 384SP • **DISPLAY** None • **OPERATING SYSTEM** None • **WARRANTY** Three years RTB • **DETAILS** [www.asus.com](http://www.asus.com) • **PART CODE** PN50-BBR048MD

Windows overall	123
Multitasking	128
Dirt Showdown	30fps
Metro: Last Light	FAIL

0% -50 Reference +50 +100  
See page 88 for performance details



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## DUAL SCREEN LAPTOP

# LENOVO

## ThinkBook Plus

COMPUTER  
SHOPPER  
BEST BUY



£918 • From [www.lenovo.com](http://www.lenovo.com)

### VERDICT

Adding a second E-Ink screen on top of this laptop is an unusual, but ultimately successful, gambit

**LENOVO IS A** practised hand at incorporating E-Ink displays – the kind you’d get on e-readers such as the Amazon Kindle – into its laptops, resulting in forward-thinking dual-screen devices at lower cost and battery life impact than if there were a second IPS or OLED screen.

The problem so far has been that, on both the original Yoga Book series and the more recent Yoga Book C930 (*Shopper* 378), the E-Ink screen always replaced the keyboard and trackpad, forcing the screen to replicate them (unconvincingly) as purely digital inputs.

With the Yoga Book Plus, Lenovo has seemingly found a more sensible place to put the second screen. It sits on top of the lid, with a conventional 13.3in IPS display on the other side and, mercifully, a proper physical keyboard and trackpad in the base.

### HANDLE WITH CARE

This isn’t a flippy convertible like anything in the Yoga Book family, but it shares a fair few design traits: a strong, sturdy hinge, sensible styling and high build quality throughout. At 174mm thick and weighing 1.4kg, the ThinkBook Plus is neither the pinnacle of ultraportable lightness nor an unappealingly chunky notebook. In fairness, the lid needs to make room for two screens, and there’s a little side benefit of this extra thickness: there’s enough of a flat edge to the lid’s sides that the bundled stylus can clamp on to either side magnetically. This is better than having it stick to either side of the base, where it could get in the way of the ports.

The E-Ink display measures a tablet-sized 10.8in across the diagonal. However, before becoming too wowed by having a screen essentially on the outside, remember it’s located in a place that’s usually built to protect the laptop, from knocks and shocks when being carried in a bag, or from the weight of anything that might casually be stacked on top of it when the lid is shut. On balance, we prefer this design to one where the second display replaces the physical keyboard, but it means the ThinkBook Plus really needs to be handled with kid gloves, lest you scratch or crack its USP.

Luckily, there’s a rigidly padded carrying case included in the box – a great freebie, as is the comfortably-proportioned stylus.

Also deserving a mention are the speakers. Laptop speakers are, by and large, rubbish, but

there’s a surprising amount of depth and warmth to the ThinkBook Plus’s downward-firing drivers. This is a rare laptop that’s good enough for casual music listening as well as Zoom calls.

It’s a little telling that the only Lenovo laptops without great keyboards are the ones that ditch them in favour of digital keys. The ThinkBook Plus shows that the old ways can be the best: its perfectly sized and spaced keys, which depress with a satisfying firmness, are a pleasure to type on.

There’s no little red mouse pointer or physical left and right mouse buttons, as per the traditional ThinkPad style, but the smooth and sprightly trackpad meant we didn’t miss them. Its diving board mechanism for click inputs also grants decisive and sharp feedback.

### MAKE IT DOUBLE

The main screen keeps things relatively simple. It’s a 13.3in, non-touch IPS panel running at 1,920x1,080, and it mostly performs as well as

it needs to. The resolution is sharp enough for a screen of this size, and as it covers 92% of the sRGB gamut with a high 1,559:1 contrast ratio, colours have an impactful punch.

At the same time, a couple of limitations prevent it from being much better than merely decent. We measured peak brightness at 340cd/m<sup>2</sup>, which is a bit middling, and its average delta-E of 7.89 is downright awful. In other words, the main screen is nice enough for web usage and creating documents, but don’t expect to use the ThinkBook Plus for any remotely colour-sensitive work.

The E-Ink display sounds even more shackled: it has the same 1080p resolution and works as a touchscreen, but is only black and white. Using the onscreen menu buttons also reveals a lack of responsiveness that’s at odds with the ThinkBook Plus’s performance elsewhere, often taking several seconds between a selection and the desired action.

Yet the secondary screen doesn’t feel like a gimmick. At a basic level, it can be used as a digital notepad for quick scribbles or calculations – swishes of the stylus are, mercifully, registered much faster than menu selections – but it’s also a very handy tool for annotating PDFs with far less faff than a mouse and keyboard would involve.

### HALLOWED SCRAWLS

It’s clever, too. Select a section of handwritten notes, and you can copy a text version to Windows’ clipboard. From there, it’s simply a case of popping the main screen back up and pasting the transcription. It’s reasonably accurate, too, with the odd exception such as turning an ‘o’ into a sad face emoji.

Of course, a lot of this functionality isn’t new to 2-in-1 laptops, including Lenovo’s previous E-Ink devices. However, having the touchscreen component on top of the lid, instead of merged with the main display, as on a conventional convertible, means that you don’t need to flip the whole thing on a 360-degree hinge so that the keyboard is





Even without the E-Ink display, the ThinkBook Plus would be a perfectly respectable ultraportable

awkwardly exposed on the underside. This, in turn, keeps the ThinkBook Plus's stylus-wielding side feeling a little more intuitive, even though the screen is monochrome and can be slow to respond.

It also allows you to essentially customise the laptop's appearance, as you can set single images or a carousel to show on the E-Ink screen when not in use. There's the option to display Windows notifications when the lid is closed, too.

We tested the ThinkBook Plus's base model, comprising a quad-core 1.6GHz Intel Core i5-10210U, 8GB of RAM and a 256GB SSD. For £1,170, you could get a Core i7-10510U, 16GB of RAM and a 512GB SSD.

We never felt slowed down by the Core i5 chip, however. In our 4K benchmarks the ThinkBook Plus scored 75 overall, which will be more than enough for general office software. Notably, it's drastically faster than the Yoga Book C930, which only scored a distinctly disappointing 25 overall.

The SSD is impressively nippy, too. We recorded a sequential read speed of 2,615MB/s, which is up there with the very fastest on the market, and its 1,833MB/s sequential write speed is very quick too. Really, the only issue with speed here comes when you want to use a menu on the E-Ink screen.

JUST A SIP

Its battery test result of 9h 30m is also a considerable improvement on the Yoga Book C930. That said, if you want a laptop specifically to handle long stretches away from the mains, it's worth looking elsewhere: the Dell XPS 13 (Shopper 392), Samsung

Galaxy Book S (Shopper 391) and HP Spectre Folio (Shopper 380) all made it past 10 hours.

Don't blame the second display for this, either. E-Ink screens only consume power when the image changes, so unless you're actively doodling on the screen or using it to navigate files, the secondary screen isn't an extra drain at all. This is what allows the ThinkBook Plus to display your chosen image on the lid at all times, even when it's completely shut down.

The ThinkBook Plus covers the basics on physical connectivity, albeit not much else: you get two USB3 ports on the right edge, plus one USB Type-C port, a combined mic/headphone jack and a full-size HDMI output on the left. Any kind of SD or microSD card slot is conspicuously missing, and although having USB Type-C is nice, it's also the charging port, so you lose it while topping up.

Conversely, Wi-Fi 6 connectivity and Bluetooth 5.0 make for a formidable wireless arsenal, and there is one neat trick hidden next to those USB 3.0 ports: the power button is also a fingerprint sensor. Despite its initially concerning thinness, it had no trouble at all reading our prints in an instant.

GOOD THINKING

Even without the E-Ink display, the ThinkBook Plus would be a perfectly respectable mid-range ultraportable. It's well made, extremely comfortable to type on, and offers decent horsepower without knacker-ing battery life for it.

Throw in the added functionality of a secondary touchscreen, and for under £1,000 the ThinkBook Plus starts to look like a very good deal indeed. It's important to remember that this isn't a dual-screen laptop in the same vein as Asus's ZenBook Duo UX481 or ZenBook 14 UX433FA, which keep their colour screens to hand to provide extra functionality while you're still primarily using the keyboard and trackpad; here, it's either/or, as while you don't need to close the lid fully to access the E-Ink panel you will at least need to turn the chassis around.

This isn't an inherently inferior approach, however, as the lid position allows for a much larger screen, which is therefore better at replicating the note-taking and annotation talents of a tablet, all without the cost and battery drain of turning the main IPS display into a touchscreen.

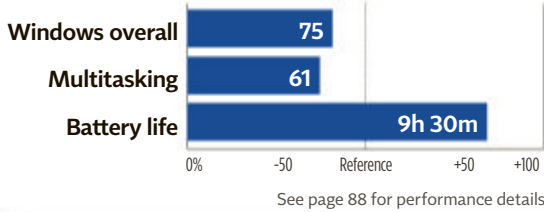
As long as you're careful not to crack it, then, the ThinkBook Plus is Lenovo's most successful E-Ink experiment so far, and a fine alternative to 2-in-1 convertibles.

James Archer



SPECIFICATIONS

PROCESSOR Quad-core 1.6GHz Intel Core i5-10210U • RAM 8GB • DIMENSIONS 308x217x17.4mm • WEIGHT 1.4kg • SCREEN SIZE 13.3in • SCREEN RESOLUTION 1,920x1,080 • GRAPHICS ADAPTOR Intel UHD Graphics 620 • TOTAL STORAGE 256GB SSD • OPERATING SYSTEM Windows 10 Pro • WARRANTY One year RTB • DETAILS [www.lenovo.com](http://www.lenovo.com) • PART CODE 20TG000RUK





## DELL XPS 15 (2020)

£2,499 • From [www.dell.com](http://www.dell.com)

## VERDICT

A gorgeous laptop with a modicum of gaming ability and a fabulous display – mostly

**DESPITE BEING ONE** of the best 15.6in laptops ever, the Dell XPS 15 hasn't had a major design update for years. Suffice to say that we were very pleased when, earlier in 2020, Dell announced that a big overhaul was imminent.

With a new slim, lightweight design to match its smaller sibling, the XPS 13 (*Shopper 392*), the new XPS 15 aims to establish itself as the laptop of choice for those who value performance as much as they do portability.

## ONLY THE BEST

It's also something of an answer to the 16in Apple MacBook Pro (*Shopper 391*). It's primarily designed for professional users who want more power beneath their fingertips and in their laptop bag than a traditional ultraportable might offer.

As such, 2020's Dell XPS 15 comes stuffed with high-powered components. You have the choice of either a hexa-core Intel Core i7-10750H or an octa-core Core i9-10885H, accompanied by a discrete Nvidia 1650 Ti GPU and a range of RAM and storage options. And it's all squeezed into a chassis that's easy to sling in a rucksack and carry around from location to location.

The biggest update from a physical point of view this year is the screen, which is now practically bezel-free on all four sides. Previously, the XPS 15's InfinityEdge display had a relatively large bezel at the bottom, but that's now largely disappeared.

It's also worth noting that there's no longer an OLED display option for the Dell XPS 15, but since the 4K touchscreen on this year's model is a wide-gamut unit rated at 100% Adobe RGB coverage, that isn't too much of a loss.

## HIGH IN FIBRE

Whichever of the specifications you choose, the Dell XPS comes in the same, slim, tough-feeling body. The laptop measures 345x230x18mm when closed and weighs 1.83kg for the non-touch variant or 2.05kg for this 4K model. That's pretty good for a 15.6in workstation laptop, and the USB Type-C power supply is remarkably small and light, too, tipping the scales at an additional 443g.



The finish is smart, **with smooth**, matt aluminium covering the lid and underside, and a natty carbon-fibre finish surrounding the keyboard and wrist rest. The whole lot feels incredibly solid: there's barely a creak or groan when handled, and the lid is reassuringly stiff and flex-free.

There isn't much in the way of legacy connectivity here, aside from the presence of a full-size SD card slot and a 3.5mm headset jack, but there are three USB Type-C ports, two of which support Thunderbolt 3.

Wireless connectivity, meanwhile, is handled by a 2x2 MIMO Killer Wi-Fi 6 AX1650s card with Bluetooth 5.1 support.

## TRUE COLOURS

The XPS 15's keyboard is excellent. It has plenty of travel and lots of lovely feeling positive feedback. The layout is great, too, with large left and right Shift keys, a double-height Enter key and a power button in the top-right corner that doubles as a fingerprint reader.

The diving board touchpad is, likewise, a joy to use. It's absolutely massive, measuring 151x90mm in size, it worked reliably and

responsively during testing, and the left and right clickers have just the right responsiveness. They're not too heavy or too light, and the sound that accompanies each press has a quiet thunk to it instead of the brittle plastic clack of some touchpads.

The 4K screen on our review sample was, likewise, top quality. It has a resolution of 3,840x2,400, which gives an aspect ratio of 16:10, and the extra height this gives over shorter or 16:9 displays is a boon for productivity applications such as Adobe Photoshop and Premiere.

Not only that, but – unlike so many displays on Windows laptops – the display Dell has chosen to use is a wide-gamut unit. Where most laptop screens are capable of reproducing only the sRGB colour space, or marginally more than that, the 4K screen on the Dell XPS 15 can go well beyond.

Indeed, keen photographers will be pleased to discover that the panel covers more than the AdobeRGB (107.7%) gamut, which bodes well for professional photographers and those needing to work in wider colour spaces than sRGB. That equates to around 156.4% of the standard sRGB gamut and 110.8% of DCI-P3.

Peak brightness is also very good at 464cd/m<sup>2</sup>, and the display's contrast ratio of 1,518:1 ensures images have plenty of pop and verve.

Colour accuracy also hits the heights. You'll need to make sure the HDR Windows settings are disabled (otherwise adaptive contrast ruins everything) but, with that done, you'll be rewarded with an average delta-E of 1.23.

## STRUCK BY LIGHTING

And if all that wasn't impressive enough, the Dell XPS 15's display is also HDR400-certified and Dolby Vision-capable. However, this is where things start to fall apart somewhat, due in no small part to the display's rather heavy-handed use of adaptive contrast.







Enable HDR in the Windows settings, fire up the Netflix app and you'll see that many recent shows are listed with Dolby Vision logos, showing that something is, indeed, working correctly. The problem is that, where an advanced TV might deploy local dimming to achieve the high contrast ratio required by Dolby Vision, only dimming and brightening specific parts of the screen, the XPS 15 appears to dim and brighten the entire display.

This is noticeable, and more than a little disconcerting, especially where scenes transition from relatively dark to quite bright, with the adaptive contrast lagging a second or two behind cuts.

That's not the only issue, either. Enable HDR and the laptop appears to cap frame rates at 30fps, with the result that all onscreen animations, as well as games, appear to drag horribly. We'd advise against using Windows' HDR mode at all as a result, even though this means missing out on one of the key benefits of the new 4K display.

### SHOW OF STRENGTH

These issues also put paid to the idea that you might use the XPS 15 to game in HDR, which is a shame because the hardware is reasonably capable.

Our review unit's Intel Core i7-10750H CPU and GTX 1650 Ti graphics card isn't the most powerful combination you can get at this price: Gigabyte's Aorus 15G (*Shopper 391*) offers more for less, as does the 2020 Razer Blade 15, albeit without that luscious wide-gamut 4K display. Even so, the XPS 15 is undoubtedly a mighty powerful laptop, scoring 191 overall in our 4K benchmarks.

The sequential write speed of the 1TB Micron SSD is a mite disappointing at 985MB/s – the sequential read speed is much higher, at 2,008MB/s – but again, the XPS 15 is more than fast enough to take on demanding creative applications such as heavy-duty raw photo editing and video editing.

It also managed a smooth 62fps in Metro: Last Light Redux, which is lower than the

## The XPS 15 is more than fast enough to take on demanding creative applications such as photo and video editing

130fps of the Razer Blade 15 and especially the 185fps of the Aorus 15G, but for a non-gaming laptop that's not bad, and is enough to max out the display's 60Hz refresh rate.

Battery life, too, is quite good for a large laptop. In our video rundown test, the Dell XPS 15 lasted 7h 24m with the display set to 170cd/m<sup>2</sup>, HDR disabled and flight mode engaged. That's a match for the 16in MacBook Pro and superior to both the Aorus 15G and the Razer Blade 15. You'll still need to run to the mains at least once a day, but the laptop should last you past lunchtime as long as you ensure you're not doing anything too demanding with it.

### HARD WORKER

All of which leads us to the verdict, which is a tricky thing to deliver on the Dell XPS 15 (2020). That's because, while there are plenty of things to love about this laptop, there are also some aspects that disappoint.

Let's start with the positives. The build quality is excellent – on a par with anything Apple has to offer – and the display quality is great. The keyboard and touchpad are beyond reproach, and there's enough power to cope with the most demanding creative applications. It's also vastly cheaper than the equivalent 16in MacBook Pro specification.

On the other hand, that wide-gamut display doesn't deliver on its Dolby Vision-enabled promises in a convincing manner. And if gaming is your priority, there are rival Windows laptops that offer more performance bang for your buck.

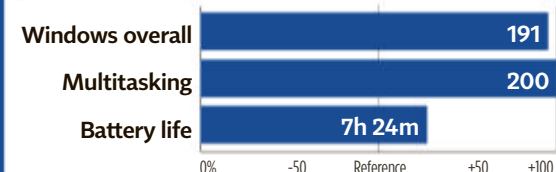
Despite its foibles, however, the Dell XPS 15 (2020) remains a very good laptop for professional creatives. If you want a 16in MacBook Pro rival for less, it's a great choice.

*Jonathan Bray*



### SPECIFICATIONS

**PROCESSOR** Hexa-core 2.6GHz Intel Core i7-1065G7 • **RAM** 32GB • **DIMENSIONS** 296x199x14.8mm • **WEIGHT** 2.05g • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 3,840x2,400 • **GRAPHICS ADAPTOR** 4GB Nvidia GeForce GTX 1650 Ti • **TOTAL STORAGE** 1TB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** [www.dell.com](http://www.dell.com) • **PART CODE** cnx9508sc



See page 88 for performance details



## MID-TOWER PC CASE

# MSI MPG Gungnir 110R

COMPUTER  
SHOPPER  
RECOMMENDED



£90 • From [www.overclockers.co.uk](http://www.overclockers.co.uk)

### VERDICT

A smart, well-cooled ATX case that shows MSI has a keen eye for impactful improvements

**MSI MAKES MANY** good PC cases, but none has quite had that comprehensive brilliance of the best chassis designs from NZXT, Cooler Master or Thermaltake. The Gungnir 100 (*Shopper 380*) was one such near-miss, being a very well-equipped case in some places, yet too simplistic in others.

The Gungnir 110R, however, is a promising replacement. In addition to matching many of its predecessor's finer qualities, it makes small but significant enhancements that could allow it to break through to the best.

### GLASS ROOTS

Several of these changes focus on aesthetics. Instead of a plain plastic front panel, for instance, the entire left half has a tempered glass window, matching the full-size glass side panel. Through this you can view the three 120mm intake fans, which have also been upgraded with addressable RGB lighting. The PSU shroud also now has a cutout in the side, showcasing the power supply while still hiding the cables – not a bad addition if you've got one of an increasing number of light-up PSUs.

It's not all just about flashing lights, thankfully. The front I/O panel still has two USB3 ports and separate mic and headphone jacks, all of which are now joined by another USB Type-C port. It's nice to see that MSI has made this modernising change by simply adding the Type-C port and not removing one of the full-size connectors in its place.

This case also directly addresses one of our big disappointments with the Gungnir 100: its lack of easily removable dust filters. Here, both the top and front fan mounts have mesh filters that can be quickly removed and replaced when cleaning, the top filter using magnets to attach and the front using plastic clips.

Very quickly, then, the Gungnir 110R establishes itself as a considerable improvement in design terms. The vented top panel also doesn't flex as much we recall the Gungnir 100's did, and the triangular section at the top of the front panel changing from solid plastic to perforated metal will help with airflow, too. The only setback we noticed was that two of the cable routing holes above the motherboard tray have lost the rubber grommets that they had on the Gungnir 100, but that's hardly catastrophic.

Once again, MSI has also done very well on cooling. Three fans at the front and an exhaust fan at the back – also 120mm – is about as good as you can expect from a sub-£100 mid-tower, and that front trio ensures that both the entirety of the main chamber and the shrouded PSU can receive refreshing cold air.

For even more airflow, you can add up to two 120mm fans or two 140mm fans in the roof, though when it comes to installing a watercooling radiator, don't plan on fitting a 280mm unit here: while 240mm radiators are fine, we found the combined bulk of a 280mm radiator and its attached fans would make it bump into the system's RAM modules instead of fitting snugly above.

### JUST ADD WATER

Mounting a radiator in the front slots also requires that you both remove the existing intake fans and move the 3.5in drive cage backwards slightly, but both are doable with a little screwdriver work, and afterwards you can fit 240mm, 280mm or even 360mm watercoolers without further issue.

All four pre-installed fans connect to a six-header hub behind the motherboard tray, so you can add two more RGB-enabled

components (such as a motherboard or just a lighting strip) and keep all the lighting in sync.

One area in which the Gungnir 110R doesn't move forward much is storage support. As with the Gungnir 100, you get a relatively basic sum of two 3.5in drive trays (which can also hold 2.5in drives) and two 2.5in mounting brackets. That's fine for most home PC builds – especially if you're using the M.2 slots on your motherboard – but for workstations or other high-end systems that require a lot of large drives, it's less ideal.

One of the 2.5in mounts has moved from the rear side to sit on top of the PSU shroud, which is neither a hindrance nor an improvement unless you want to show off an SSD through the window. Alternatively, you could simply remove the unused bracket for a cleaner look – it's good for the Gungnir 110R to at least have this flexibility.

### BANG TIDY

Cable management, meanwhile, is respectable, despite the loss of a couple of grommets. Even without deep grooves for routing, a set of easily reusable Velcro straps keeps everything clean and untangled, while the routing holes around the motherboard tray are both plentiful and spacious.

Better looking, more practical and not a penny more expensive than last year's effort, the 110R sees the Gungnir series come good. If it had a bit more vertical space for larger watercoolers it would be even better, but we'd still gladly recommend this case for first-time and mid-level builds of almost any sort.

*James Archer*

### SPECIFICATIONS

**CASE TYPE** Mid-tower • **MOTHERBOARD COMPATIBILITY** Mini-ITX, microATX, ATX • **SUPPLIED FANS** 4x 120mm • **MAX 3.5in DRIVE BAYS** 2 • **MAX 2.5in DRIVE BAYS** 4 • **DIMENSIONS** 450x215x430mm • **WEIGHT** 7.9kg • **WARRANTY** One year RTB • **DETAILS** [www.msi.com](http://www.msi.com) • **PART CODE** MPG Gungnir 110R





960GB SATA SSD

KIOXIA Exceria

COMPUTER SHOPPER  
RECOMMENDED ★★★★★  
£95 • From [www.ebuyer.com](http://www.ebuyer.com)



VERDICT

Simple but speedy, especially when writing data

**IF YOU'VE NEVER** heard of Kioxia, you might be reassured to know that it's essentially just a rebrand of Toshiba Memory – unless, that is, you're also aware of the Shingled Magnetic Recording (SMR) episode earlier this year, where Toshiba, Seagate and WD admitted to covertly using slower SMR technology in their hard disk production.

Perhaps the Exceria, a SATA-based 2.5in SSD, can win back some goodwill. At a time of PCI-E 4.0 drives using NVMe memory it's on the basic side, and is only available in 240GB, 480GB and 960GB varieties; these aren't especially durable either, being rated at 60TBW, 120TBW and 240TBW respectively.

However, all three have the same quoted speeds of 555MB/s reads and 540MB/s writes, showing that Kioxia is being ambitious on performance and isn't allowing the smaller capacities to fall behind. We tested the 960GB model, and it was almost spot on the quoted read speed in CrystalDiskMark: 554MB/s for sequential reads.

Its sequential write speed of 514MB/s was behind the official figure, however, and this dropped to 305MB/s in the 4K random test. That said, both this result and its 311MB/s in the 4K read test are respectable, even edging ahead of the Samsung 870 QVO (below).

The Exceria also managed some excellent write speeds in our own file transfer tests. In the huge test it shot to 574MB/s, pushing the SATA interface to its limits. In the large file test it returned an average write speed of 618MB/s, which is partly the result of a Windows error wherein files are transferred faster than the OS can keep up. Even the small files test, by far the most difficult of the three, only slowed write speeds to 540MB/s.

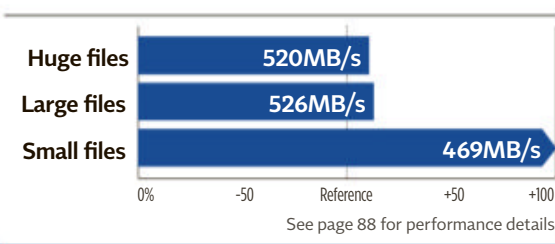
The only disappointment is that it didn't repeat such performances on read speeds, with 465MB/s in the huge files test, 434MB/s in the large files test and 397MB/s in the small files test. Unlike with write speeds, there's a big difference in how the Exceria handles read operations with non-sequentially stored data

compared to sequential files. This holds the Exceria back from competing with the very best on performance, but then it does have an ace to play: it's cheap. The 960GB model is a mere 9.9p per gigabyte, and at 11.5p for the 480GB model and 13.3p for the 240GB model, the other capacities aren't far behind on value. Thus, as a budget upgrade from a hard disk, the Exceria is a good buy.

James Archer

SPECIFICATIONS

CAPACITY 960GB • COST PER GIGABYTE 9.9p • INTERFACE SATA • CLAIMED READ 555MB/s • CLAIMED WRITE 540MB/s • WARRANTY Three years RTB • DETAILS [www.kioxia.com](http://www.kioxia.com) • PART CODE TR20960G00



2TB SATA SSD

SAMSUNG 870 QVO

★★★★☆  
£209 • From [www.scan.co.uk](http://www.scan.co.uk)



VERDICT

The 870 QVO takes SSD capacity to new heights, but is less pioneering with its speed

**ONE PROBLEM FACING** SSD manufacturers is that, when it comes to pure speed, there are already numerous drives that hit the limits of what the SATA interface can allow.

Samsung's QVO range takes a different tack, focusing on ballooning capacities instead of speed. The 870 QVO takes this philosophy further than ever, introducing a gigantic 8TB option alongside 1TB, 2TB and 4TB capacities.

We were only sent the 2TB version for review, but all four models in the line-up have the same quoted 560MB/s read and 530MB/s write speeds. Those are as high as we were hoping for, considering this SSD's relation to the outstanding Samsung 860 Evo, though integral to the 870 QVO's higher capacities is its use of QLC memory, as opposed to the 860 Evo's faster but less dense TLC.

The 870 QVO had no problem meeting its maximum speeds in the CrystalDiskMark sequential tests, landing a 563MB/s read and a 533MB/s write speed, though the weakness

of QLC was more apparent in the 4K random tests: here, the 870 QVO fell to a read speed of 307MB/s and a write speed of 295MB/s.

Switching to our more realistic file transfer tests, the 870 QVO also took a beating: in the easiest huge file test it could only read at 453MB/s on average, far slower than its much more impressive write speed of 553MB/s.

In both the large and small file tests, write speeds remained high while read speeds faltered. There was an especially sizable gap in the small test, where the 870 QVO produced a 369MB/s read speed and a 562MB/s write speed, and in the large test its 446MB/s read speed disappointed even as its 588MB/s write speed proved a pleasant surprise.

It's probably not entirely fair to compare this SSD to the 860 Evo: they use different memory technologies, and the absence of sub-1TB capacities shows that the 870 QVO is targeting more a specialist audience. At the same time, it's hard not to wish read speeds

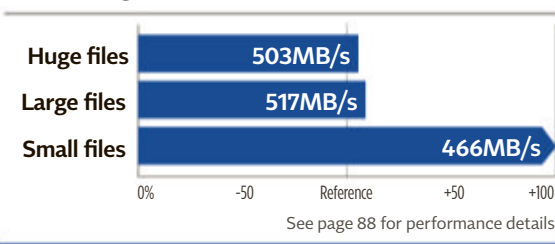
were consistently higher, knowing what Samsung is capable of with SATA SSDs.

Then again, the 870 QVO's high outlays belie some startlingly low per-gigabyte costs: 10.1p for 1TB, 10.4p for 2TB, 10p for 4TB and 9.9p for 8TB. This affords it a bit of leeway, and there's no denying this is a lot nimbler than any high-capacity hard disk.

James Archer

SPECIFICATIONS

CAPACITY 2TB • COST PER GIGABYTE 10.4p • INTERFACE SATA • CLAIMED READ 560MB/s • CLAIMED WRITE 530MB/s • WARRANTY Three years RTB • DETAILS [www.samsung.com](http://www.samsung.com) • PART CODE MZ-77Q2T0BW





INKJET MULTIFUNCTION PERIPHERAL

HP DeskJet Plus 4120



£60 • From [www.amazon.co.uk](http://www.amazon.co.uk)

VERDICT

The DeskJet Plus 4120 is a cheap office-biased MFP, but opt out of Instant Ink and it will cost a fortune to run

HP'S DESKJET PLUS 4120 is a compact inkjet multifunction peripheral (MFP). Although it's aimed at home users, it has a distinct office flavour, skipping photo features in favour of a 35-page automatic document feeder (ADF). There's also support for both 2.4GHz and 5GHz wireless networks, but no wired Ethernet connection.

In truth, this is otherwise quite a basic device. On the top panel there's a smattering of membrane buttons and LEDs, together with a basic mono LCD screen. At the back there's a simple 60-page input tray, and a 25-page output tray in front. Neither the printer nor the ADF support duplexing.

There's no setup disc, so your first stop is a visit to the relevant app store or to HP's website. You can install the HP Smart app, or jump through various hoops to get the full PC software via the EasyStart setup. We're not overwhelmingly keen on either choice: the app is easier to use, but we'd like more advanced options in both.

GONNA BE SEDATED

This is generally an unhurried device. After delivering a first page of black text in about 13 seconds, it went on to print our 25-page text test at only 8.1 pages per minute (ppm). Switching to draft quality improved this 11.7ppm with little loss of quality. Colour



Buy your own supply of HP's 305XL cartridges, and these will work out at a better-lie-down-in-a-darkened-room 16p per page

printing was very slow, with our mixed graphics test inching out at just 2.0ppm. This isn't really a photo device, with pigment-based black ink and no support for borderless printing. At the Max DPI setting, two 10x8in photos took more than half an hour, while six 6x4in photos took more than 18 minutes.

Scans weren't too slow at lower resolutions. HP's restrictive scan interface doesn't allow scanning at 150 dots per inch (dpi), but at 300dpi it took 20 seconds to capture an A4 page. We captured a 6x4in photo at 600dpi in 37 seconds, but the same job at 1,200dpi needed almost two minutes.

Single-page copies weren't especially quick, at 20 seconds in black and 37 seconds in colour. We tried our 10-page ADF copy several times, but the printer repeatedly warned of a paper jam, despite there being no obvious physical problem.

Unimpressive photo prints aside, this MFP produced good results. Plain paper prints were bold and punchy, and copies were well exposed with accurate colours. Document scans were crisp, and photo scans were more than good

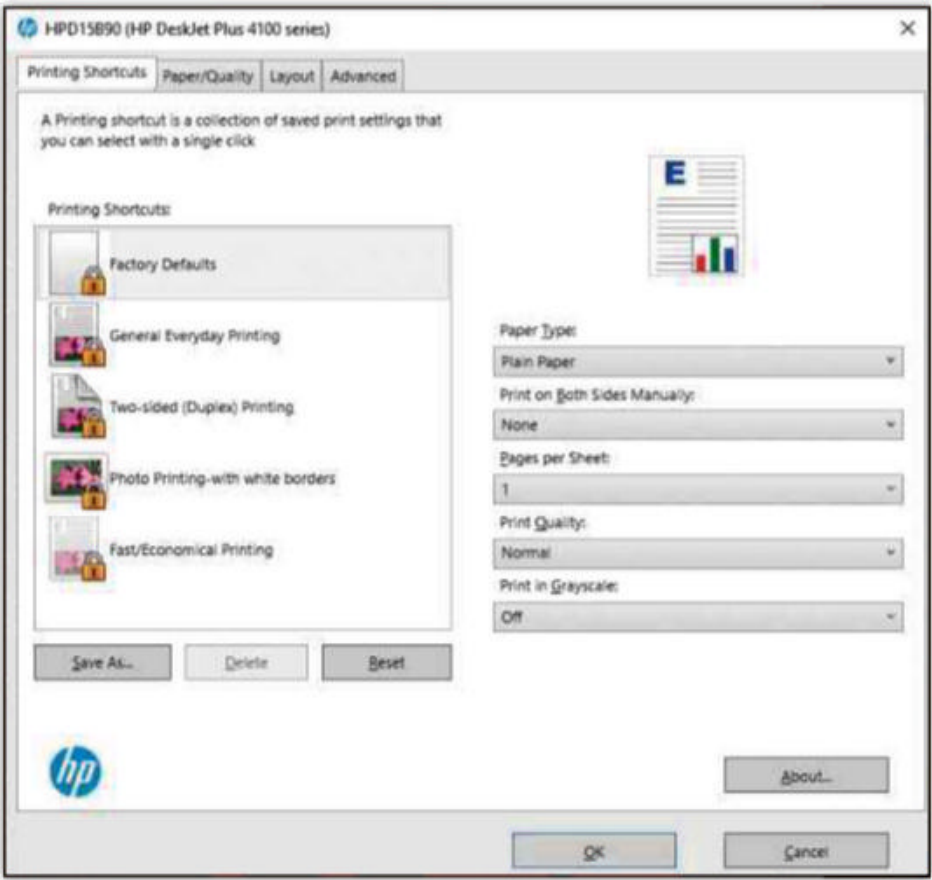
enough for occasional use, despite some loss of detail among the very darkest shades.

IN FOR A POUND

If you're considering the DeskJet Plus 4120, it's important to understand its running costs. Buy your own supply of HP's 305XL cartridges and these will work out at a better-lie-down-in-a-darkened-room 16p per page. Of this, the 7.6p per page black component is the highest we've yet seen. However, go with a subscription to HP's instant Ink service and the printer will self-order cartridges as it needs them. You'll pay as little as 2.7-4.0p per page, but only if you print the full number of pages included in your monthly subscription.

Overall, this is a reasonable but slow MFP for the money, and it's a terrible photo printer. It could make sense for everyday document use, but you'll need to pick the right Instant Ink plan.

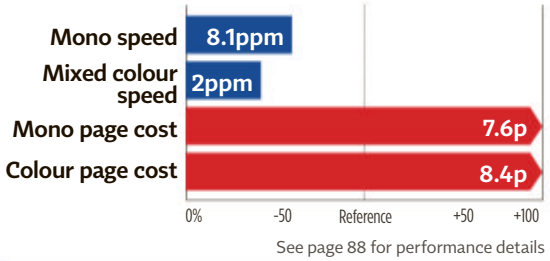
Simon Handby



There are shortcuts for printing settings, but output is still slow

SPECIFICATIONS

TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH) 1,200x1,200dpi (24-bit) • DIMENSIONS 261x428x446mm • WEIGHT 4.8kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS [www.hp.co.uk](http://www.hp.co.uk) • PART CODE 3XV14B





## WIRELESS IN-EAR HEADPHONES

# LG Tone Free FN6



£90 • From [www.johnlewis.com](http://www.johnlewis.com)

### VERDICT

The charging case may break down bacteria, but the LG Tone Free FN6 don't break the wireless earbud mould

**IF THERE'S AN** ideal time to release earbuds with a bacteria-killing case, in the midst of a global pandemic is probably it. The LG Tone Free FN6 deliver that particular function via a set of UV lights within the charging case, which after 10 minutes can apparently kill 99.9% of bacteria on the speaker mesh of each bud.

Otherwise, however, this is an unremarkable pair of true wireless headphones. Audio quality is reasonable, as are the fit and earbud design, but unless aural hygiene is your top priority, there are better options in the Tone Free FN6's price range.

### WIGGLE ROOM

For £129, you get a pair of water- and sweat-resistant (to the IPX4 standard) earbuds that support the AAC and SBC Bluetooth codecs; those that want to make use of hi-res audio codecs such as aptX will need to look elsewhere. The Tone Free FN6 have short stems that house touch-sensitive panels and you get three sizes of hypoallergenic silicone eartips to choose from.

Also in the box is that compact charging case, which can be topped up using the included USB Type-C cable or charged wirelessly. The buds offer six hours of audio playback per charge, while the case has enough juice for two full charges, making a total of 18 hours' playtime, which is a little disappointing by current standards. The RHA TrueConnect 2, for example, provide a staggering 44 hours of playback.

Using the largest set of eartips, we were able to achieve a very secure fit that provided an impressive amount of passive noise cancellation. The buds felt stable in our ears and no amount of head-shaking was able to dislodge them.

The fit isn't without its issues, however: after around an hour of use, we began to experience ear fatigue. Switching to the medium-sized eartips alleviated the pressure somewhat but came at the cost of a less snug fit and more external noise making its way in.

Fit will differ dramatically from person to person but, using the various

options available, we were ultimately unable to achieve a truly comfortable fit that remained fully secure.

### CAR STRUCK

LG teamed up with audio manufacturer Meridian – known for engineering automotive audio systems for Jaguar and Range Rover – to create the EQ for the Tone Free FN6. Sadly, this pedigree hasn't translated into headphones all that well. The default profile is dependable and capable of getting the job done, but lacking dynamism or flair. Bass in particular leaves a fair bit to be desired, as there's just not enough low-end clout to do bass-heavy genres true justice. Vocals fare better, however, with decent clarity in higher registers.

After jumping into the Tone Free companion app, the audio experience moved up a couple of gears, solely due to the Immersion EQ, one of four Meridian-created presets. The profile injects much-needed volume and energy, and although the results didn't elevate the Tone Free FN6 to the sonic levels of the likes of the RHA TrueConnect 2, Libratone Track Air+ or 1MORE

True Wireless ANC, they sounded a darn sight better than the default sound signature.

What really sets the Tone Free apart from its rivals is its UVnano charging case. By using ultraviolet light, it's able to destroy molecular bonds of bacteria, thus making them far more hygienic than your average buds. The case needs to be connected via the USB-C cable for the cleaning function to activate, however, so simply popping the buds into the case while you're

out and about will recharge them but not blast any bacteria with the UV light.

The Tone Free FN6 also feature simple touch controls that worked consistently throughout testing. A single tap on either bud plays or pauses audio, a double-tap increases or decreases volume depending on which bud you hit, and triple taps control track skipping.

The companion app is one of the better-implemented audio apps we've used, and allows you to create two of your own EQ profiles in addition to switching between the four Meridian presets. You can also remap the touch controls, lock the touchpads, check the battery life of your buds and locate them by activating a chirping sound if they're within Bluetooth range.

Other features include an Ambient Sound mode, which doesn't work especially well, and auto-pause when the buds are removed from your ears, which is much more useful.

### CLEANING SOLUTION

If you're prone to ear infections or concerned about the spread of germs while using earbuds (which is perfectly understandable, particularly in the current climate), the Tone Free FN6 are certainly worth a look.

If, however, a bacteria-killing case doesn't appeal, save yourself some money and pick up either the RHA TrueConnect 2, which sound phenomenal, or the Urbanista London, which throw active noise cancellation into the mix. And for those that want to avoid anything going in their ears at all, the AfterShokz Aeropex use bone conduction rather than needing to be lodged in your ear canals.

*Andy White*



### SPECIFICATIONS

HEADPHONES SUBTYPE In-ear • PLUG TYPE None • WEIGHT 5.4g • CABLE LENGTH N/A • WARRANTY One year parts and labour • DETAILS [www.lg.com](http://www.lg.com) • PART CODE HBS-FN6





# PC SPECIALIST



## CUSTOM GAMING DESKTOPS & LAPTOPS



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CONFIGURATOR



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AWARD WINNING  
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# COBALT PRO

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ASUS® TUF Z490-PLUS GAMING  
16GB Corsair VENGEANCE 2666MHz  
8GB GEFORCE RTX 2070 SUPER  
256GB PCS 2.5" M.2 SSD  
2TB SEAGATE BARRACUDA HDD  
Genuine Windows 10 Home

This spec from  
**£1,541.99**



# OPTIMUS PRO

15.6" Matte Full HD 120Hz Screen  
AMD Ryzen™ 7 Eight Core Processor 4800H  
8GB Corsair 2400MHz DDR4  
4GB GeForce GTX 1650 Ti  
128GB ADATA SX6000 LITE M.2  
Genuine Windows 10 Home

This spec from  
**£920.99**



# COBALT ELITE

Intel® Core™ i5-10600K  
ASUS® PRIME Z490-P  
8GB Corsair VENGEANCE 2400MHz  
6GB GEFORCE GTX 1660 SUPER  
256GB PCS 2.5" M.2 SSD  
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## OVER-EAR HEADPHONES

# KOKOON Relax Sleep Headphones



£297 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

Despite the high price, the Kokoon Relax are worth checking out if you're plagued by sleepless nights

**THERE ARE FEW** things more important in life than sleep, something the Kokoon Relax understand very well. These aren't just headphones, but headphones designed to help you get a good night's rest. They do so by combining an ultra-comfortable design, active noise cancellation (ANC), a companion app featuring an extensive library of relaxing content, and electroencephalogram (EEG) technology to track your sleep.

### PILLOW TALK

The first thing you'll notice about the Kokoon Relax are their oversized earcups. They're designed to sit as flat on your head as possible so as to minimise any discomfort for those who sleep with the side of their head against the pillow. Inside the earcups are flexible silicone linings that mould around your ears, while the outer casing of the cups is made of a breathable fabric to prevent overheating during use.

When worn out of bed, they are extremely comfortable. At 350g, they aren't too heavy, and the fabric-covered headband sits unassuming on top of your head.

While in bed they're equally comfortable, as long as you're on your back. Kokoon explicitly states that you should use a deep, plush pillow, and for good reason: if you're using a flatter pillow and sleep on your side, the pressure the cups exert against your head makes dropping off difficult.

At least to begin with, anyway. After a few failed nights, we eventually got used to how they felt, and even in the middle of a heatwave we didn't wake up with hot or sweaty ears; the breathable earcups are evidently effective.

The headphones themselves are only half of the Kokoon Relax package: the accompanying app, which is available on both Android and iOS, is integral to how the headphones work.

Before you can get started, you're asked a few questions about your sleeping habits and instructed to listen to five introductory sessions of

between 10 and 15 minutes in length. Once in the app, you'll find a wide range of audio files designed to help you relax during what Kokoon calls 'The Buffer Zone': the time you take to relax before bedding down for the night. These include breathing exercises and other relaxation techniques used in CBT-I (Cognitive Behavioural Therapy for Insomnia), soundscapes, music and coloured noise.

While listening to a file, the sensors inside the earcups measure the electrical activity in your brain and record it in the My History section of the app. As more information is collected, the app learns what works in getting you off to sleep and begins to suggest what it deems the most suitable sleeping aids.

For sessions shorter than 2h 30m, you'll only see how long you were awake and asleep for, but longer sessions provide more detailed sleep tracking, showing what percentage of your slumber was light, deep or in rapid eye movement (REM). The data collected overnight is informative, but data from some shorter listening sessions can seem somewhat misleading. The app would often show that we had been asleep for periods of time when we were very much awake.

### NIGHTLY ROUTINE

Still, sleep tracking is pretty neat feature, as is another of the Kokoon Relax's little tricks: once you've drifted off, audio volume is decreased and replaced by white noise, helping to ensure a smoother snooze.

Battery life on the Kokoon Relax clocks in at around 13 hours, which is less than two good nights' sleep. That means if you use them every night, you're going to need to do a lot of charging via the Micro USB cable included in the box.

It's not a dealbreaker – we're all used to charging our phones every day by now – but a few extra hours would have been welcome.



Audio quality could also be better, but as these headphones are primarily designed to help you sleep, the lack of a more exciting sound signature is possibly intentional. The sound created by the 40mm dynamic drivers is passable when using the headphones outside the bedroom, but don't expect them to sound anywhere near as good as other over-ear headphones in their price bracket.

The soundstage is very narrow and bass is lacking in richness, although mids and treble are handled well enough. We actually used them to listen to music quite a bit, owing to how comfortable they are, and both passive and active noise cancelling do a decent job at reducing external sound. ANC improves the overall audio profile as well, making everything sound fuller and more balanced.

### REST BUY

That's not enough to make these headphones worth buying for someone who doesn't have any particular issues with sleep; the variety of tools can create a more bed-ready mindset, but they're still more of a specialist product.

What the Kokoon Relax do have going for them is their ability to track and analyse your sleep and adapt accordingly. When this works as intended, it provides an informative insight into your sleep patterns and creates an ever-evolving roadmap to better sleep, so while they're not an instant fix, these headphones could form one part of a wider set of techniques to help insomniacs.

Andy White



### SPECIFICATIONS

HEADPHONES SUBTYPE Over-ear • PLUG TYPE 3.5mm (optional) • WEIGHT 345g • CABLE LENGTH 1m • WARRANTY One year RTB • DETAILS [www.kokoon.io](http://www.kokoon.io) • PART CODE K1V0BW



# MOTOROLA Moto G 5G Plus



£300 • From [www.johnlewis.com](http://www.johnlewis.com)

## VERDICT

The first truly affordable 5G smartphone is no cut-back lightweight, especially where performance is concerned

**EVEN IF YOU** happen to live in one of the few 5G hotspots dotted around the UK, there's a good chance you still won't be able to afford the entry fee. Only a small handful of smartphones can access these faster mobile data speeds, and they tend to be flagship devices that cost the best part of £1,000.

Still, a few phones have tried to bring down the 5G network's high barrier for entry since it was first switched on last May. Samsung's Galaxy A90 5G (*Shopper 385*) managed to push the SIM-free cost down to a more considerate £669, but thankfully, the Moto G 5G Plus is much cheaper than that.

## NEW LOOK

Design-wise, the Moto G 5G Plus is a bit of a departure from the rest of Moto's budget offerings. The Moto G 5G Plus looks rather swish, in fact, with a neat iPhone 11-like square camera housing at the back, and an oblong fingerprint reader – which doubles as the power button – on the phone's right edge. Motorola has opted to include a 3.5mm headphone socket, which sits next to the solitary speaker grille on the bottom, alongside the USB Type-C charging port.

It's still made of plastic, however, with relatively thick bezels around all four sides of its gigantic screen, and is only 'water repellent', not waterproof. Despite this, the Moto G 5G Plus still feels like a considerable step up from the rest of Moto's budget-friendly line-up.

Not only is this the first 5G-equipped Moto G phone, but the Moto G 5G Plus is also the first with a silky-smooth 90Hz screen. It has support for HDR playback and an aspect ratio of 21:9, measures 6.7in across the diagonal, and has a resolution of 2,520x1,080. There's no notch, but a couple of small holes have been bored out of the top-left corner for the two selfie cameras.

As usual with Moto phones, there are three display modes to choose from, and we found that the Natural screen

setting was the most colour-accurate in our tests. With sRGB colour gamut coverage of 93% and an average delta-E of 1.02, the Moto G 5G Plus's screen barely places a foot wrong, with only slight inconsistencies in the red tones. For the price, you really can't do better than this.

Contrast is a smidgen on the dull side, however, with a ratio of 1,265:1, although it more than makes up for this with a high peak brightness of 575cd/m². On an even more positive note, HDR-supported content looks punchy and vibrant, although it does fail to match the iPhone 11 in that regard.

## POWERED UP

In order to access the 5G network, the Moto G 5G Plus uses a Qualcomm Snapdragon 765 processor. This is the same chipset that powered Moto's first 5G phone, the Motorola Edge (*Shopper 391*), which is quite surprising when you consider that the Moto G 5G Plus costs almost half the price.

As for the technical goodies, this 5G chipset includes an octa-core CPU that's built using a 7nm fabrication process and clocked at 2.3GHz. It's a tad slower than the Snapdragon 865, but it still makes the Moto G 5G Plus much faster than any budget phone has any right to be, and it scored 591 in Geekbench 5's single-core test and 1,880 in the multicore test.

Besides this being the fastest budget Moto G handset by a considerable margin, the Moto G 5G Plus's barnstorming performance beat the similarly priced Galaxy A51 in Geekbench as well as the GFXBench Manhattan gaming test, in which Motorola's phone averaged a slick 44fps onscreen result and 50fps onscreen.



The Moto G 5G Plus is also expandable by up to 1TB via microSD and comes with a massive 5,000mAh battery, which lasted 22h 15m in our video rundown test – another very good result indeed.

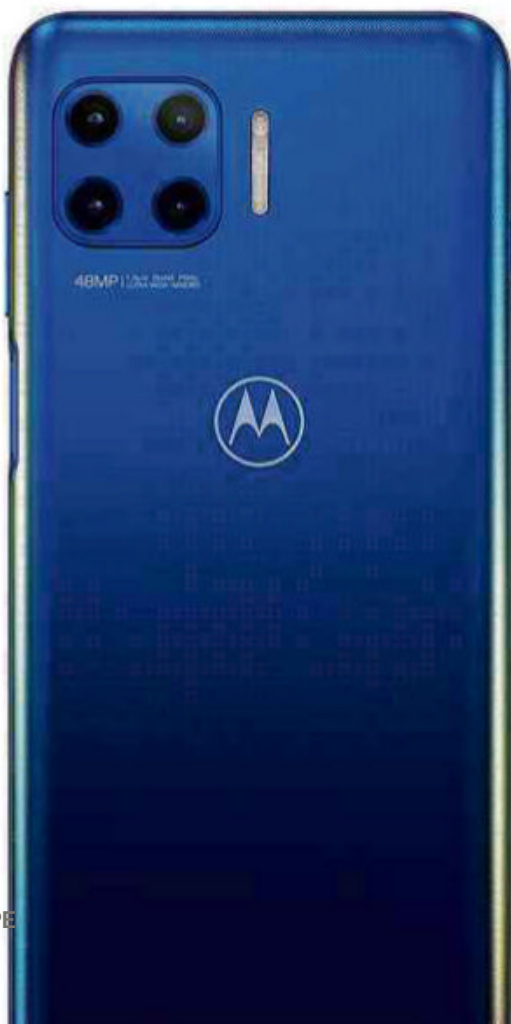
The Moto G 5G Plus has four cameras on the rear, including a 48-megapixel camera (which captures 12-megapixel images by default), a 118°, 8-megapixel wide-angle camera, a 5-megapixel macro lens with a 2cm focus distance, and a 2-megapixel depth-sensing unit. Unusually, it also has two selfie cameras on the front: a 16-megapixel snapper, and an 8-megapixel wide-angle camera.

In testing, the Moto G 5G Plus's cameras picked up plenty of detail, with pleasingly neutral colours and an auto-exposure that's nice and balanced. The Moto G 5G Plus's images are still a touch over-processed, but not distractingly so. Rest assured, what you're getting here is still of exceptional quality for the price, and the portrait mode is especially good. The macro sensor – while probably only of interest as a novelty – does the job well, too.

## FORWARD THINKING

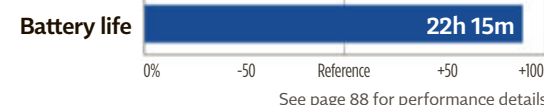
The Moto G 5G Plus is a splendid addition to the Moto G line-up, and a major breakthrough when it comes to 5G accessibility in the UK. If you're one of the lucky few to live in an area with reliable 5G coverage and you'd like to benefit from these faster speeds while picking up the cheapest handset possible, then the Moto G 5G Plus is a no-brainer.

Nathan Spendelow



## SPECIFICATIONS

- PROCESSOR Octa-core 2.3GHz Qualcomm Snapdragon 765
- SCREEN SIZE 6.7in
- SCREEN RESOLUTION 2,520x1,080
- REAR CAMERAS 48 megapixels, 8 megapixels, 5 megapixels, 2 megapixels
- STORAGE 64GB
- WIRELESS DATA 5G
- NFC Yes
- DIMENSIONS 168x74x9mm
- WEIGHT 207g
- OPERATING SYSTEM Android 10
- WARRANTY One year RTB
- DETAILS [www.motorola.co.uk](http://www.motorola.co.uk)
- PART CODE PAK90015GB





# SAMSUNG Galaxy Note 20 Ultra

COMPUTER  
SHOPPER  
RECOMMENDED



£1,179 • From [www.samsung.com](http://www.samsung.com)

## VERDICT

Samsung's latest plus-sized smartphone brings a bigger screen, a bigger battery and a bigger price

**THE TERM 'PHABLET'** might not be as common in tech parlance as it once was, but Samsung's work-friendly Galaxy Notes are still the first handsets that spring to mind when you think of big-screened smartphones. Despite outlasting the designation once used to define it, the Note is back once again, and this time around Samsung isn't resting on its laurels when it comes to upgrades.

Continuing the two-phone tradition it started last year, there are two models of Note 20 to mull over in 2020. The Galaxy Note 20 Ultra is primed to steal the limelight this year, since it's where you'll find all the extra bells and whistles – albeit for an outrageous £1,179. And that's just the 256GB model; 512GB of storage will set you back £1,279.

Considering how much Samsung wants you to pay for one, the Galaxy Note 20 Ultra represents the very pinnacle of Samsung's Android achievements thus far. No stone has been left unturned, it seems, with Samsung throwing in a handful of high-end upgrades that were initially introduced in the Galaxy S-series of phones earlier in the year.

That list includes Samsung's most up-to-date flagship processor, the Exynos 990, as well as a 6.9in 120Hz screen, a 108-megapixel camera (accompanied by wide-angle and telephoto zoom lenses) and 5G as standard. Since this is a Note device, the S Pen also returns with a handful of new features, along with DeX mode, Samsung's desktop-like interface, which now supports wireless screen mirroring.

## ALL GROWN UP

Design-wise, the Galaxy Note 20 Ultra lives up to its moniker. As you can probably tell from the photos, it looks like an especially large handset with monstrous physical dimensions. It's certainly up there in size terms, though it's not so big that we felt it at risk of simply dropping out of our grasp.

Looks can be deceiving, since despite the increase in screen size, it's actually not much bigger than last year's Note 10. Measuring 77mm wide, 165mm tall and 8.1mm thick, the Note 20 Ultra is roughly the same size as the iPhone 11 Pro Max, and it doesn't feel overly bulky either, weighing 208g. Unlike the regular Note 20, it also has curved sides, which squeeze more comfortably into your palm.

The Note 20 Ultra's 6.9in screen absolutely dominates the first impression. A neat hole-punch notch can be found at the top-centre portion of the display, which houses the 10-megapixel selfie camera, and it also has some of the skinniest bezels we've ever seen on a handset.

Flip the phone over, however, and you encounter the first of Samsung's aesthetic missteps. The

rectangular camera housing, which sits in the top-left corner, is quite unsightly. It takes up a lot of space, increases the weight of the top portion of the handset, and protrudes a noticeable 4mm. We're also not hugely fond of the harsh-edged top and bottom sides, and there's no 3.5mm headphone jack, either.

## GET TO THE POINT

Naturally, the S Pen stylus returns, although its interior housing has switched sides and is now in the bottom-left corner instead. There are a few minor upgrades this year, most notably when it comes to writing precision: the Note 20's S Pen has a speedy 9ms latency, which is a 40% improvement over last year's model. There are five new waggle-like gestures, too, including a feature that allows you to shake the S Pen to take a screenshot, and then directly annotate it if you wish.

If you have wonky handwriting, then the phone's note-taking software is now able to straighten your words, and you can also attach voice recordings to your notes, allowing you to read and listen at the same time. Other work-friendly improvements include a PC-like folder and sub-folder structure, deeper Windows integration, auto-saves to the cloud, and wireless DeX functionality with any TV or monitor that supports screen-mirroring.



As for play, both Note 20 phones are among the first to support Microsoft's Project xCloud game-streaming service. So long as you have an active Xbox Game Pass Ultimate subscription (both phones come with a three-month pass), you'll be able to stream and play over 100 Xbox games. You'll have to pair a compatible Bluetooth controller in order to play these games, however.

## RAZZLE DAZZLE

As for the display, this is the first Note device with a buttery-smooth 120Hz refresh rate. The caveat, however, is that you can't enable the 120Hz setting at the native screen resolution of 3,088x1,440. Instead, as on the Galaxy S20, you have to dip the resolution down to FHD+ in the phone's display settings. The regular Note 20, which costs £330 less, doesn't have this problem, of course, since it only uses a simple 60Hz panel.

The screen itself is a Dynamic AMOLED panel that also supports HDR10+ content. There are two display modes to choose from, with the phone's Natural profile being the most accurate of the two in terms of colour reproduction. In this mode, the Note 20 Ultra is capable of covering 93.7% of the sRGB colour gamut, with a total volume of 95.2% and an average delta-E of 3.3.

Colour accuracy could therefore be better, though the Note 20 Ultra is certainly bright,





The Note 20 Ultra is the culmination of Samsung’s bi-annual flagship launches, and it’s pretty much everything you could ask of a modern flagship

peaking at 688cd/m² with the auto-brightness setting engaged, which is more than enough to ensure that the screen is readable in sunny conditions. Likewise, HDR 10+ content on Netflix, Amazon Prime Video and YouTube looks sublime, with deep, rich colours and boosted highlights in darker scenes.

FINE SPRINT

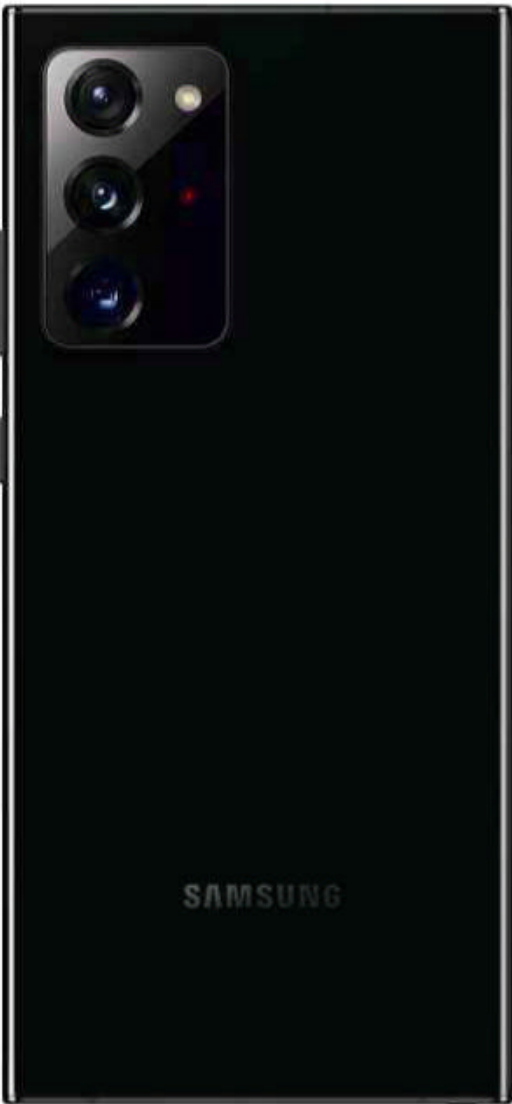
The Note 20 Ultra is powered by Samsung’s latest in-house flagship chipset, the Exynos 990. This speedy octa-core processor has a maximum clock speed of 2.73GHz, and it proved to be a very capable performer in our benchmarking tests, particularly Geekbench 5, in which it scored 946 in the single-core test and 2,765 in the multicore test.

That represents a 32% improvement on the previous generation Exynos 9825, which powered the Galaxy Note 10. It’s no surprise that the Note 20 Ultra finds itself among the very best on the market when it comes to raw speed potential, but then you’d certainly hope so considering the price.

Gaming performance is equally rapid. The 120Hz screen really comes into play here, with the GFXBench Manhattan 3 test resulting in an average 94fps onscreen result and 101fps offscreen. Provided the app supports it, of course, you should expect to reach above 60fps in a wide variety of titles.

Elsewhere, there’s a healthy 12GB of RAM for multitasking, as well as either 256GB or 512GB of internal storage. While the vanilla Note 20 doesn’t have expandable storage, the Ultra model has a microSD slot, which can take cards up to 1TB in capacity.

The Note 20 Ultra also has a larger battery, at 4,500mAh, with support for 25W charging speeds; the Note 20 Ultra can charge up to 50% from empty in just 30 minutes.



In our video rundown test, it lasted 18h 26m at native screen resolution – slightly less than the Note 10+, but respectable enough given its bigger, thirstier screen. Interestingly, if you dial the resolution down to FHD+ but increase the refresh rate to 120Hz, the Note 20 Ultra’s stamina is decreased by roughly 14%.

SPACE FARER

The Ultra’s camera offering is also slightly different to the regular model, most notably when it comes to Space Zoom. Both phones have a triple-camera array at the rear, but the regular Note 20’s telephoto unit can only hybrid zoom up to 30x, while the more expensive Note 20 Ultra is capable of zooming up to 50x.

In a practical sense, this discrepancy is hardly worth buying the more expensive phone for. Where the Note 20 Ultra does beat its Note 20 stablemate is with its massive 108-megapixel main camera unit, which works with the 12-megapixel zoom sensor and a 12-megapixel ultrawide sensor.

Like the Galaxy S20, the Note 20 Ultra can capture video at up to 8K resolution, although you will have to drop the resolution down to 4K if you want to record at 60fps. Samsung has also updated the camera

software, and you can now enable an onscreen histogram, as well as audio level indicators. The zoom slider has also been improved, and you can now tinker with multi-source mic controls, if you decide to pair the phone with a Bluetooth microphone.

CROWNING ACHIEVEMENT

The Note 20 Ultra is the culmination of Samsung’s bi-annual flagship launches, and it’s pretty much everything you could ask of a modern flagship. There’s no doubt that it’s a rapid performer, but it also takes great pictures, its screen is an absolute delight, and its software experience is as equally refined as the Galaxy S20’s.

But there is one major sticking point, and that’s the high launch price. Starting at £1,179, the Note 20 Ultra is leg-shakingly expensive, and other than the three months of Xbox Game Pass Ultimate, there aren’t any freebies to help sweeten the deal.

Still, the Galaxy Note 20 Ultra doesn’t necessarily need a handout. It sets out to be the most unashamedly luxurious Android smartphone around and, on a technical level, it’s largely succeeded. If you can afford to take advantage of that, go ahead.

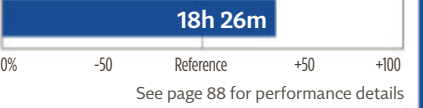
Nathan Spendelow



SPECIFICATIONS

- PROCESSOR Octa-core 2.73GHz Samsung Exynos 990
- SCREEN SIZE 6.9in
- SCREEN RESOLUTION 3,088x1,440
- REAR CAMERAS 108 megapixels, 12 megapixels, 12 megapixels
- STORAGE 256GB
- WIRELESS DATA 5G
- NFC Yes
- DIMENSIONS 165x77x8.1mm
- WEIGHT 208g
- OPERATING SYSTEM Android 10
- WARRANTY One year RTB
- DETAILS www.samsung.com
- PART CODE SM-N986B

Battery life



See page 88 for performance details



## 4K VA TV

# SONY KD75XH9005



£1,999 • From [www.johnlewis.com](http://www.johnlewis.com)

### VERDICT

A stunning big-screen TV that serves up impressive HDR performance

**SONY HAS LAUNCHED** 10 families of TVs in the UK this year, ranging from affordable 4K LCDs to premium 4K OLED and 8K LCD models, but the XH90 range is arguably the most interesting of the bunch. Why? It's the only group of Sony's 2020 TVs that's prepared for silky-smooth 120Hz 4K gaming and packed with niceties such as Variable Refresh Rate (VRR) and eARC support.

Before you get too excited, these screens – including the 75in KD75XH9005 model on test – don't have all these HDMI 2.1 features out of the box. They'll be added as part of a firmware update due later this year.

Thankfully, it's not all about the gaming. The KD75XH9005 is simply a great all-around 4K TV with impressive HDR performance and incredible motion handling. And unlike most 75in rival TVs, it's actually fairly affordable.

### FULL FAT

The XH90 line-up replaces the XG85 from 2019, but with one huge upgrade: the old IPS edge-lit panel type has made way for a VA-type LCD with full-array local dimming (FALD). As a result, the KD75XH9005 delivers a higher maximum brightness, punchier images and better screen uniformity than its predecessor.

Sony has also equipped the KD75XH9005 with its X1 4K HDR picture processor, which is a step down from the X1 Ultimate chip you'll find in Sony's flagship models. That said, it still has X-Motion Clarity black zone insertion technology and supports the HDR10, HLG and Dolby Vision HDR formats. Meanwhile, the KD75XH9005's smart platform is based on Android TV 9.0 and grants access to all the streaming apps you'd expect, from Netflix and Disney Plus to the free UK catch-up services.

Considering that it's using direct-lit LED backlighting with FALD, the KD75XH9005 is a sleek-looking beast. The chassis flares out at the rear to accommodate the FALD backlighting, but it has relatively thin bezels, which are finished in a snazzy silver trim. The only niggle is that those reflective bezels may draw unwanted attention to themselves.

The KD75XH9005 sits on a pair of metallic feet situated at either end of the TV, and this means you'll need a suitably wide TV stand. If



that doesn't suit, you could always go for an XH907, XH9096 or XH92 variant; these models allow the feet to be placed inwards to suit narrower AV furniture.

All of the KD75XH9005's connections are located to the left rear of the display. It has four HDMI ports, two of which – namely HDMI 3 and HDMI 4 – are HDMI 2.1. Of those, HDMI 3 is the only designated port for ARC and eARC sources.

### ACOUSTIC SESSION

The KD75XH9005 has what Sony calls an 'Acoustic Multi-Audio System' made up of dual speakers backed up by additional sound positioning tweeters. For TV speakers, the soundstage is solid and the bass has a kick, but they still can't beat an external soundbar or home theatre system. As for audio enhancement, the KD75XH9005 supports Dolby Atmos as well as DTS Digital Surround.

Sony includes a nice black remote with the same shape and layout as its more premium control – but without backlighting – and shortcut buttons for Netflix and Google Play.

Speaking of applications, the KD75XH9005 has all the usual paid-for streaming platforms: Disney Plus, Amazon Prime Video and Rakuten TV, as well as Netflix and Google Play.

As in previous years, you can access UK catch-up apps through the integrated

YouView service, although now it's no longer essential to go directly through YouView. All you need to do is agree to YouView's T&C's during setup and all the individual apps, from BBC iPlayer to My5, will be available from the home screen.

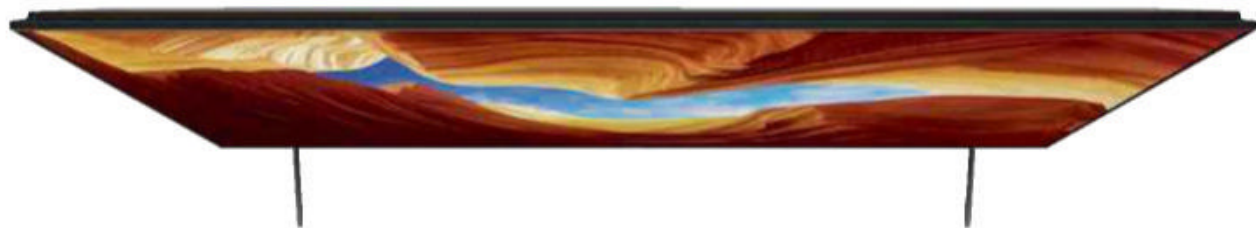
The KD75XH9005 and its XH90 brethren are the only Sony TVs so far to use the new MediaTek MT5895 processor, which is supported by 3GB RAM. As a result, navigation is blazingly fast and super responsive.

### GOOD CLEAN FUN

While there are fewer colour calibration controls on the KD75XH9005 than on Sony's flagship X1-Ultimate powered TVs, it can still be calibrated to accurate levels. Following our calibration, we measured an average delta-E of only 1.27, and in real-world viewing the colours and skin tones look realistic and natural.

Panel uniformity is top-notch, too, especially considering this is a 75in LED LCD TV. On full-field grey slides, there was no banding whatsoever and only minimal dirty screen effect (DSE), with a slight darkening visible in the corners. In day-to-day use, you wouldn't notice the DSE at all.

The KD75XH9005's motion control is better yet. It's capable of native 24p movie playback, even when the Motionflow setting isn't engaged. This allows for smooth panning shots in 24fps films, without the faintest hint of judder. And even after cranking the smoothness right up to its maximum settings, 24p playback isn't as thickly slathered with soap opera effect as we've seen on previous Sony TVs.







Technically speaking, the KD75XH9005 has a baseline motion resolution of 300 lines on 50/60Hz content. X-Motion Clarity – activated by setting Smoothness to 2 and Clearness to 1 – boosts the motion resolution all the way up to 1,080 lines, and it's only at this point that soap opera effect is evident during 24p playback.

Overall, Sony's motion interpolation tech is the best among the TV brands, introducing the least interpolation artefacts with no noticeable frame skipping or stuttering.

By LED LCD standards, the VA panel on the KD75XH9005 is able to achieve exceptionally deep blacks. It doesn't use a viewing angle compensation film, however, so colours and contrast levels degrade when the

TV is viewed off-axis. Just as with any other TV, it's best to face the KD75XH9005 head-on when watching or gaming.

### ILLUMINATING DISCOVERY

There are only 32 local dimming zones on the KD75XH9005, laid out on a 4x8 grid; that's really not a lot, and it shows. Sony might have one of the best local dimming algorithms in the business but, due to the physical limitations, there is some inevitable blooming and backlight fluctuation.

The algorithm prioritises accuracy over blooming suppression, meaning that the KD75XH9005 exhibits more shadow detail and brighter subtitles than you'd see on a Samsung QLED, at the cost of having more noticeable blooming (or haloing) of faint light around bright objects on the screen.

Upscaling of standard-definition content to 4K is decent enough on the KD75XH9005, but clearly inferior to the results achieved by Sony's top X1 Ultimate chipset. It's particularly unforgiving with bit-starved, heavily compressed content, because the KD75XH9005's black gradation is poorer than other Sony TVs we've tested, and there's no Smooth Gradation control to smooth out in-content posterisation.

The KD75XH9005 can hit a peak brightness of 680cd/m<sup>2</sup> on a 10% window after calibration and 540cd/m<sup>2</sup> at full-field. Colour coverage is good, too, with a DCI-P3 coverage of 95% that translates to a Rec 2020 coverage of 71%.

Bright HDR scenes look much more vivid on the KD75XH9005 than they do on similarly priced OLED TVs, mainly because it's not held back by an Auto Brightness Limiter. With that said, images don't have as much dazzling impact as on the higher-end Sony XH95 or Samsung Q95T ranges.

Sony's tone-mapping algorithm favours preserving overall brightness over highlight detail and, on occasion, bright highlights may appear blown out. HDR10 content looks excellent, though the Dolby Vision playback isn't quite so impressive.

The KD75XH9005 actually uses the low-latency (or player-led) version of Dolby Vision, which isn't as effective as the standard TV-led version. This can have an impact on daily viewing. For example, we spotted some unsightly near-black posterisation when playing Netflix content in Dolby Vision.

The big selling point of the KD75XH9005 – and indeed the other XH90 models – over its 2020 Sony stablemates is the promised support for HDMI 2.1 features. Sony indicates that the HDMI 2.1 firmware update will grant the KD75XH9005 access to features such as 4K 120Hz playback, ALLM for auto-enabling Game Mode and VRR for tear-free gaming. This makes it a solid choice for gamers looking to pick up a new TV before the PlayStation 5 and Xbox Series X hit the shelves.

Response times are extremely quick on the KD75XH9005 once Game Mode is engaged (we had to activate it manually), with an input lag of only 18ms. That's speedy, but it's not quite class-leading these days; the Samsung Q95T has an input lag of 10ms and the LG CX has a response time of only 6ms on a 4K/120Hz signal.

With the Sony PlayStation 5 on the way later this year, you'd think Sony would want to make sure all of its high-end TVs were HDMI 2.1-ready. As it stands – and provided Sony makes good on that firmware update promise – the Sony XH90 range is a better choice for gamers than the Sony XH95, which is limited to 60Hz at 4K and lacks VRR and ALLM.

Frustratingly, that HDMI 2.1 support has yet to materialise. With no deadline set for the firmware update, it's a bit of a gamble buying from the XH90 family right now.

### FUTURE STAR

Once HDMI 2.1 lands, the KD75XH9005 will be much more tempting. And even without HDMI 2.1, this is a good all-rounder that represents excellent value for money, particularly so when compared to rival 75in models.

Yes, pricier Samsung and Sony full-array local dimming TVs offer a better all-round viewing experience, but they cost an awful lot more, too. The KD75XH9005's picture quality is more than acceptable for a mid-range option, and it serves up vibrant HDR and exemplary motion handling.

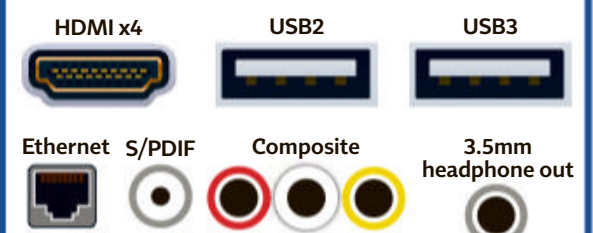
Vincent Teoh



### SPECIFICATIONS

SCREEN SIZE 75in • NATIVE RESOLUTION 3,840x2,160 •  
VIDEO INPUTS HDMI • TUNER Freeview HD, Freesat HD •  
DIMENSIONS 1,107x1,810x186mm • WARRANTY One year  
RTB • DETAILS [www.sony.co.uk](http://www.sony.co.uk) • PART CODE KD75XH9005

#### CONNECTION PORTS





# SAMSUNG Galaxy Watch 3



£419 • From [www.samsung.com](http://www.samsung.com)

## VERDICT

An attractive, full-featured smartwatch, but it doesn't improve on its predecessor as much it needs to

**IN SPITE OF** its name, the Galaxy Watch 3 is technically only the second Galaxy Watch Samsung has made. There have been two sporty Samsung smartwatches released in the two years since the original Galaxy Watch first launched – the Galaxy Watch Active (Shopper 380) and Galaxy Watch Active 2 (Shopper 390) – but this is the first proper upgrade to the company's flagship smartwatch.

The new model has a slimmer, more lightweight design than its admittedly rather chunky predecessor, along with a larger screen, but for all its design improvements it doesn't offer a huge amount in the way of new features or performance boosts, making it rather tricky to recommend at its high launch price.

## ON THE UP AND UP

Like the original Galaxy Watch, the Galaxy Watch 3 comes in two sizes – 41mm and 45mm – both of which have the brilliant rotating mechanical bezel that Samsung's flagship watches have become renowned for.

The smaller model starts at £399 for the Bluetooth-only variant and comes in bronze and silver, while the larger model costs £419 and is available in black and silver. That's £120 more than the starting price of the Galaxy Watch, which is a fairly steep 40% price hike, though the new model does come with a genuine leather strap.

As with the first Galaxy Watch, another £40 gets you the 4G variant, irrespective of which size you pick. That means a 45mm 4G Galaxy Watch 3 will set you back the princely sum of £459.

Although the Galaxy app store is notoriously limited compared to both Apple's Watch OS and Google's Wear OS equivalents, one of the main perks is that the OS's native Spotify app lets you store playlists for offline playback. Both sizes of Galaxy Watch 3 come with 8GB of onboard storage, of which you can use around 4GB to store songs for playing when you're out of range of your phone.

There's also NFC for making contactless payments via Samsung Pay, a speaker and a

microphone, which allows you to interact with Samsung's digital assistant Bixby and make calls from your wrist. Rather disappointingly, however, when you consider it's almost two years newer, the Galaxy Watch 3 uses the same 1.15GHz Exynos 9110 processor as its predecessor, and has the same 1GB of RAM.

## THAT SHRINKING FEELING

On the battery front, things are even more disappointing. The 45mm model has a relatively small 340mAh battery, which is more than a 25% cut compared to the 470mAh unit used in the 46mm Galaxy Watch. Samsung promises it still typically delivers 56 hours, or just over two full days, between charges. That's significantly less than the claimed seven days on the original Galaxy Watch, although we found we could sometimes squeeze out three to four days of use between charges, while logging the occasional GPS activity.

We haven't tested it, but the 41mm model is less impaired on this front, though its 247mAh battery is still 8% smaller than its predecessor. The good news is that both models support wireless charging, so you can charge your smartwatch from any of your existing Qi wireless chargers, as well as the dedicated one included in the box.

## LESS IS MORE

The headline change is that the Galaxy Watch 3 is smaller and thinner than the Galaxy Watch, despite having a larger display. With respect to the 45mm model we received, that means the Galaxy Watch 3 has a 1.4in panel while being 1.8mm thinner and weighing 9g less than the 46mm original. The 41mm variant, on the other hand, now has a 1.2in display, and both have 360x360-resolution screens.

This certainly makes for a watch that's noticeably less bulky on your wrist and



altogether more sophisticated looking, although the 45mm Galaxy Watch 3 still isn't exactly what you'd call svelte. Indeed, compared to the much more rugged Garmin Fenix 6 Pro, the Galaxy Watch only feels marginally less chunky in everyday use. Having said that, it's impressive that Samsung has managed to squeeze in more screen real estate while making the watch that little bit more inconspicuous.

Elsewhere, the main new changes include a smattering of new fitness- and health-related features. As well as the option to measure your blood-oxygen levels using the watch's built-in SpO2 sensor, the Galaxy Watch 3 will now give you a sleep score to help you better understand your quality of sleep at a glance. Both of these features are accessible from the watch's main widgets, making it easy to use them whenever you please.

## BILL OF HEALTH

If you're a keen runner, then you'll also be pleased to learn the watch can now estimate your VO2 max – an excellent mark of your cardiovascular fitness – and even offer advanced running analysis. The watch claims it will only do the former if you run at 70% to 90% of your max heart rate continuously for 20 minutes, but it estimated ours after a workout where more than 50% of the time was spent in zone 2 (60-70% of max).

The last significant new feature is fall detection. After adding up to four SOS





contacts to the Galaxy Wearable app, you can choose which one the watch automatically calls should it detect a fall. Though the Galaxy Watch 3 can also technically perform an ECG from your wrist, much like the Apple Watch 5, unfortunately this functionality isn't available outside South Korea at launch. Besides these additions, there's not a great deal that you won't find on Samsung's previous smartwatches, including the Galaxy Watch Active series.



answer calls without having to reach for the phone. Call quality was very clear via the tiny built-in speaker, and those we spoke to reported good-quality speech on their end as well.

Sadly, despite all the improvements as far as fitness features are concerned, the Galaxy Watch 3 falls some way short of being a truly great sports watch. If you're a serious runner or cyclist, you'll be disappointed to find there's no option to set your heart-rate zones

in the Samsung Health app manually, for instance.

That might not be a problem for everyone, but if your maximum heart rate is higher than the simple 220-minus-your-age formula suggests, the watch can easily overestimate the intensity of workouts. We suspect this may also have figured in the Galaxy Watch 3 estimating a notably lower VO2 max than a Garmin watch worn on the other wrist.

Another blow for fitness junkies is that there's still no option to use a Bluetooth HR-monitor in conjunction with the watch's native fitness apps. Thankfully, we found the optical sensor to be fairly accurate, which is good news, but those wanting the very greatest accuracy from a chest strap will be better off looking elsewhere.

The other major sticking point is battery life. Samsung's flagship smartwatches have always been known for their Apple Watch-beating battery life, and although that may still be the case, it's not the clear and obvious win it once was. With Samsung itself only quoting two days of battery life, gone are the days of having to only charge your Galaxy Watch once or twice a week.

#### WEARING THIN

None of these things is a deal-breaker, especially if you're not interested in the more advanced fitness features, but when the Galaxy Watch 3 costs £120 more than its predecessor at launch, it's still rather tricky to make the case that you're getting plenty of bang for your buck.

There's no doubt the Galaxy Watch 3 is a brilliant-looking smartwatch that does the basics very well – you can even make the case that it's the best Android smartwatch you can buy – but thanks to its less-than-brand new innards and limited app store, it falls some way short of being the world-beating smartwatch it really should be for the price.

If you like the sound of the Galaxy Watch 3 but don't like the idea of stumping up so much cash, you can get a similar experience with the Galaxy Watch and Galaxy Watch Active 2, and save a considerable amount of money in the process.

*Edward Munn*

#### TURN OF SPEED

Thanks to its new improved design, the Galaxy Watch 3 looks and feels great, and it does all the smartwatch basics very well. Indeed, despite using the same chipset as its predecessor, navigating its widgets via the brilliantly tactile rotating bezel is both nippy and enjoyable, and all the information you might want relating to your health and fitness is easy to find and well presented.

Samsung also lets you pick from a wide range of watch faces, so you will almost certainly be able to find a design that puts the metrics that matter most to you front and centre at all times.

Replying to messages from a paired smartphone using the watch's canned responses is also a cinch. Unfortunately, this feature isn't available for iOS users, and neither is the option to transfer locally stored music files.

Those new running analysis insights also lift the Galaxy Watch 3's sports credentials up a notch. Remarkably, considering there are no additional sensors in the box, the watch records metrics including asymmetry, contact time, flight time, regularity, vertical oscillation and stiffness directly from the wrist. Those are insights you'd normally only associate with specialist running watches from Garmin and high-end heart-rate monitors such as the Wahoo Tickr X. The Samsung Health app also offers plenty of help on how to interpret the data to improve your running form.

#### TALK TIME

Even if you're not a running obsessive, the Galaxy Watch 3 works brilliantly as an everyday fitness tracker, letting you see how active you've been during the day, and prompting you to get up and move around if you've not done enough. It will also automatically start workouts after you've been moving for 10 minutes, which is handy if you're the sort of person who often forgets to hit the record button.

One of the main perks of owning the Galaxy Watch 3 over more basic fitness trackers, however, is the built-in microphone and speaker. Even with the Bluetooth-only variant, we found it really useful being able to

#### SPECIFICATIONS

PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.4in • RESOLUTION 360x360 • OS SUPPORT Android, iOS • BATTERY LIFE Two days • WARRANTY One year RTB • DETAILS [www.samsung.com](http://www.samsung.com) • PART CODE SM-R840NZKAEUA

qualicomp

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Create Your Own Range Only\* Minimum Spend £500.00\*\*



# Choosing a... PC system

**01** A basic PC costing around £350 will be able to run everyday office, multimedia and education software and will easily cope with surfing the internet. It might even be able to run some modern games.

Many PCs can be sold either with or without a monitor. If you don't like the display the manufacturer is offering, you can always use your current one, or buy another one separately.

**02** If you want to play games, you'll have to upgrade the graphics card. Budget cards such as the Nvidia GeForce GTX 1050 will cope well with many 3D games, but to play the latest 3D games smoothly (and enjoy the best-quality graphics) it's worth upgrading to a more powerful card such as the Nvidia GeForce GTX 1070.

**03** All modern PCs come with at least a dual-core processor and are capable of most tasks. Anyone who regularly undertakes demanding tasks such as video editing and encoding should consider a hexa-core or even an octa-core processor.

**04** There are plenty of good reasons to upgrade the PC's memory or hard disk. If you'll use your PC for gaming, video editing or other demanding tasks, you'll need at least 8GB of RAM and a large hard disk; 1TB should suffice. Many new PCs have an SSD, which speeds up the time it takes for your PC to boot and for programs to load.

**05** Having plenty of USB ports is always useful, as most computer

peripherals attach to these ports. Most new PCs come with USB3 or the latest USB3.1 ports, which provide faster data transfers when used with supported devices than the older USB2 standard.

**06** Most new PCs now come with Windows 10 pre-installed. Don't be too easily swayed by the inclusion of other software, though, as it may be that you'll never use it.

**07** While most PCs come in cases of a similar size, some have more compact mini tower or mini PC cases. These smaller PCs will fit under your TV or on your desk more easily, but bear in mind that they're significantly harder to upgrade than full-size machines.

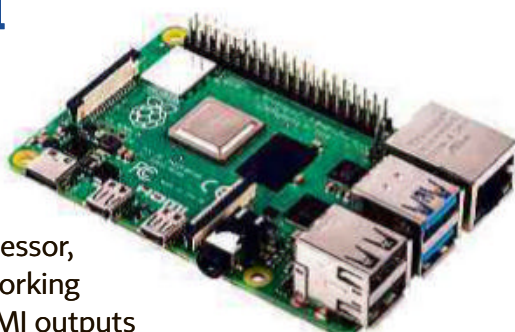
## PCs

### RASPBERRY PI

4 Model B

★★★★★

£34 • [thepihut.com](http://thepihut.com)



**COMPUTER SHOPPER**  
BEST BUY

A faster processor, quicker networking and dual HDMI outputs

make the Pi 4 a much better desktop computer than previous Pi models, and it hasn't lost any appeal as a cheap hobbyist board, either. 4K video implementation could be better – we had issues getting smooth playback in Raspbian – but that's the only noteworthy concern.

**PROCESSOR** Quad-core 1.5GHz Broadcom BCM2711 • **RAM** 1GB • **USB PORTS** 1x USB Type-C (power), 2x USB2, 2x USB3 • **STORAGE** MicroSD card slot • **DISPLAY** None • **OPERATING SYSTEM** Raspbian • **WARRANTY** One year RTB • **DETAILS** [www.raspberrypi.org](http://www.raspberrypi.org) • **PART CODE** Pi 4 Model B • **FULL REVIEW** Sep 2019

### CHILLBLAST Photo Zen

★★★★★

£1,240 • [www.chillblast.com](http://www.chillblast.com)



**COMPUTER SHOPPER**  
BEST BUY

Photographers and designers will love the Photo Zen: a PC laser-focused on media editing. To this end it has a heavily multithreaded CPU, loads of RAM, a multcard reader and even a sound-dampening case, so you can work in peace with minimal fan noise.

**PROCESSOR** Octa-core 3.6GHz AMD Ryzen 7 3700X • **RAM** 32GB • **FRONT USB PORTS** 2x USB2, 5x USB3 • **REAR USB PORTS** 2x USB2, 2x USB3, 4x USB3.1 • **TOTAL STORAGE** 500GB SSD, 2TB hard disk • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Five years labour including two years collect and return • **DETAILS** [www.chillblast.com](http://www.chillblast.com) • **PART CODE** Photo Zen • **FULL REVIEW** Oct 2020

### ACER Aspire XC

★★★★★

£400 • [www.acer.com](http://www.acer.com)

**COMPUTER SHOPPER**  
BEST BUY

Not only is the Aspire XC conveniently compact and attractively cheap, it's got more than enough horsepower to cope with most tasks and a smattering of handy extras, including built-in Wi-Fi and Bluetooth. We tested the XC-885 model with a solitary hard disk, but for a little extra you can add a faster SSD.

**PROCESSOR** Hexa-core 2.9GHz Intel Core i5-9400 • **RAM** 8GB • **FRONT USB PORTS** 1x USB3.1, 1x USB Type-C • **REAR USB PORTS** 4x USB2, 2x USB3 • **TOTAL STORAGE** 1TB hard disk • **GRAPHICS PROCESSOR** Intel UHD Graphics 630 • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year carry-in • **DETAILS** [www.acer.com](http://www.acer.com) • **PART CODE** Aspire XC-885 • **FULL REVIEW** Sep 2020



### PALICOMP AMD Abyss

★★★★★

£700 • [www.palicomp.co.uk](http://www.palicomp.co.uk)



**COMPUTER SHOPPER**  
BEST BUY

At this price, you'd seriously struggle to find a more comprehensively capable desktop system than Palicomp's AMD Abyss. It can multitask with serious applications just as well as it can run games, and with its large, fast NVMe SSD, it won't be slowed down by storage. There's a lot of room for future upgrades, too.

**PROCESSOR** Hexa-core 3.6GHz AMD Ryzen 5 2600X • **RAM** 8GB • **FRONT USB PORTS** 2x USB2, 1x USB3 • **REAR USB PORTS** 2x USB2, 2x USB3, 2x USB3.1, 1x USB Type-C • **TOTAL STORAGE** 512GB SSD, 1TB hard disk • **GRAPHICS CARD** 8GB AMD Radeon RX570 Armor 8GB OC • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Three years RTB • **DETAILS** [www.palicomp.co.uk](http://www.palicomp.co.uk) • **PART CODE** RYZ6 • **FULL REVIEW** Apr 2019



# Choosing a... Laptop

**01** A basic laptop costing around £300 will run everyday office, multimedia and education software, but it won't be suitable for 3D gaming or processor-intensive tasks such as video editing. Many laptops at this price have a 15.6in screen and weigh over 2kg, so they're best used around the house and for occasional journeys.

**02** If you want to play modern games, you'll need a laptop with a dedicated graphics chip such as the Nvidia GeForce GTX 1060M. Good gaming laptops tend to have large 15.6 or 17in screens and weigh around 3kg, so they're best suited to use at home.

**03** If you want a laptop that you can take everywhere, look for a model that weighs less than 2kg. For the best

portability, buy one that has a 13.3in or 14in screen. In general, the smaller and lighter the laptop, the more expensive it is, especially if it has plenty of processing power.

**04** Battery life is extremely important for a laptop, particularly if you'll be carrying it around. We'd expect all but the biggest and heaviest to last for at least five hours on a single charge, but for an ultraportable that you carry everywhere, eight hours and above is more desirable.

**05** Laptops use mobile versions of processors to conserve power, and these lag behind desktop chips when it comes to performance. For a budget Windows laptop, an Intel Core i3 processor will do the job, but if you

want better performance, you should look for an Intel Core i5 or Core i7 model instead. We recommend a minimum of 4GB of RAM, although 8GB is better for multitasking.

**06** Most budget and mid-range laptops use a mechanical hard disk for storage. You'll want at least 500GB, but 1TB or more is better. Solid-state drives (SSDs) have faster performance, making your computer quicker to boot and more responsive. They have lower capacities, though. You'll need at least 128GB.

**07** Convertibles and 2-in-1 laptops can change from laptop mode to tablet mode. We've listed our favourite models later on in this guide in the Tablets section.

## LAPTOPS

### SAMSUNG Galaxy Book Ion



£1,249 • [www.johnlewis.com](http://www.johnlewis.com)



If the Galaxy Book Ion is any indication, Samsung's return to the UK laptop market is a cause for celebration. This is a wonderfully light, long-lasting Windows ultraportable with great connectivity and respectable performance from its Core i5 processor.



**PROCESSOR** Quad-core 1.6GHz Intel Core i5-10210U • **RAM** 8GB • **DIMENSIONS** 306x200x12.9mm • **WEIGHT** 970g • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel UHD Graphics 620 • **TOTAL STORAGE** 512GB SSD • **OPERATING SYSTEM** Windows 10 Home • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** [www.samsung.com](http://www.samsung.com) • **PART CODE** Galaxy Book Ion • **FULL REVIEW** Oct 2020

### HONOR MagicBook 14



£549 • [www.argos.co.uk](http://www.argos.co.uk)



This budget ultraportable is a tremendous bargain. It's as fast as many £1,000-plus laptops, and has similarly high build quality too, complete with a good-looking metal chassis, backlit keyboard and wide range of ports. The display isn't pro-quality but is still big and sharp enough to get work done.



**PROCESSOR** Quad-core 2.1GHz AMD Ryzen 5 3500U • **RAM** 9GB • **DIMENSIONS** 323x215x15.9mm • **WEIGHT** 1.38kg • **SCREEN SIZE** 14in • **SCREEN RESOLUTION** 1,920x1,080 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** [www.hihonor.com](http://www.hihonor.com) • **PART CODE** NobelK-WAQ9AHNR • **FULL REVIEW** Aug 2020

### DELL Latitude 3300



£689 • [www.dell.com](http://www.dell.com)



Dell's affordable and well-built Latitude 3300 is made for students, but the fact that it has strong specs for the price can be appreciated by anyone looking for a general-purpose laptop. The quad-core CPU keeps performance up, and this particular model has a superior 256GB SSD to the even cheaper versions' eMMC drives.



**PROCESSOR** Quad-core 1.6GHz Intel Core i5-8250U • **RAM** 8GB • **DIMENSIONS** 330x231x22.9mm • **WEIGHT** 1.56kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel UHD Graphics 620 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Pro • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** [www.dell.com](http://www.dell.com) • **PART CODE** n013l330013emea • **FULL REVIEW** Jan 2020

### GOOGLE Pixelbook Go



£829 • [store.google.com](http://store.google.com)



The creator of Chrome OS has once again produced one of the best laptops for the operating system. The Pixelbook Go isn't perfect – screen brightness could be higher, for instance – but it's very powerful for a Chromebook, and manages some fantastic battery life. The keyboard is also a pleasure to type on, with comfortable, solid-feeling yet agile keys.



**PROCESSOR** Dual-core 1.3GHz Intel Core i5-8200Y • **RAM** 8GB • **DIMENSIONS** 311x206x13.4mm • **WEIGHT** 1.06kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel UHD Graphics 615 • **TOTAL STORAGE** 128GB SSD • **OPERATING SYSTEM** Chrome OS • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** [store.google.com](http://store.google.com) • **PART CODE** GA00526-UK • **FULL REVIEW** May 2020



# Choosing a... NAS device

**01** A network-attached storage (NAS) device lets you store documents, media, and other files on its hard disks so you can share them with other devices on your network. Some have disks already installed, while others are empty enclosures into which you install your own disks. Buying an empty NAS can often be the more cost-effective option, as they're usually less expensive and give you the freedom to add disks at a later date.

You should buy one with a Gigabit Ethernet interface, as these provide the highest transfer speeds. To use a NAS device at these speeds, you'll need computers with Gigabit Ethernet network adaptors and a Gigabit Ethernet switch or router. Computers with Fast Ethernet adaptors

can still access the NAS device, but only at the much slower speed of 100Mbit/s.

**02** The amount of network storage you need depends on the types of files you use. If you want to store Word and Excel documents, for example, a 1TB device will be fine. In fact, a 1TB device should be sufficient for a family's entire media collection, regardless of how many music and video files everyone owns. Small businesses should consider higher storage capacities, depending on the nature of the business.

**03** If you can see no end to your storage needs, you should buy an upgradable NAS device. Many have a USB port for adding an external disk. Devices such as

Synology's barebones NAS kits have spare disk trays for cheaper and faster upgrades.

**04** If you want extra protection for your data, look for a device that supports RAID. RAID 1 and RAID 5 arrays reduce the available capacity by duplicating data, but you won't lose it if a disk fails.

**05** If you need access to your files while you're away, look for a NAS device with an FTP server. Some can also share a USB printer across your network.

A NAS device with a Universal Plug and Play (UPnP) or DLNA media server can stream your music, photos and videos to a network media player, so you can enjoy your media collection in another room.

## STORAGE

### WD Blue SN550 1TB

★★★★★

£102 • [www.ebuyer.com](http://www.ebuyer.com)

**COMPUTER SHOPPER**  
RECOMMENDED

There are faster SSDs, but the Blue

SN550 isn't slow, either. It's therefore a good bet for when you want as much solid-state capacity for as little money as possible.



CAPACITY 1TB • PRICE PER GIGABYTE £0.10p • INTERFACE M.2/NVMe • WARRANTY Five years RTB • DETAILS [www.westerndigital.com](http://www.westerndigital.com) • PART CODE WDS100T2B0C • FULL REVIEW Apr 2020

### PNY ProElite 1TB

★★★★★

£163 • [www.amzn.to/3kqGJFo](http://www.amzn.to/3kqGJFo)

**COMPUTER SHOPPER**  
BEST BUY

A tiny, very nimble portable SSD

that's both faster and cheaper than Samsung's similar T5 drive. Just make sure to connect via a USB3.1 port to get the best performance.



CAPACITY 1TB • PRICE PER GIGABYTE £0.16p • INTERFACE USB3.1 • WARRANTY Three years RTB • DETAILS [www.pny.eu](http://www.pny.eu) • PART CODE PSD0CS2060S-1TB-RB • FULL REVIEW Feb 2020

### ISTORAGE CloudAshur

★★★★★

£99 • [www.istorage-uk.com](http://www.istorage-uk.com)

**COMPUTER SHOPPER**  
RECOMMENDED

The CloudAshur looks like a USB

drive, but it's actually a module that adds PIN-protected encryption to your files as you save them to the cloud. It's not fast, but it is effective and totally unique.



CAPACITY N/A • COST PER GIGABYTE N/A • INTERFACE USB3 • WARRANTY Three years RTB with lifetime technical support • DETAILS [www.istorage-uk.com](http://www.istorage-uk.com) • PART CODE IS-EM-CA-256 • FULL REVIEW Jun 2020

### ADATA SD600Q 480GB

★★★★★

£54 • [www.quzo.net](http://www.quzo.net)

**COMPUTER SHOPPER**  
RECOMMENDED

Put aside your fears about external SSDs being too

expensive compared to hard disks – this 480GB drive is excellent value, and decently quick.



CAPACITY 480GB • COST PER GIGABYTE £0.11p • INTERFACE USB3 • CLAIMED READ 440MB/s • CLAIMED WRITE 430MB/s • WARRANTY Three years RTB • DETAILS [www.adata.com](http://www.adata.com) • PART CODE ASD600Q-480GU31-CBL • FULL REVIEW Aug 2019

### KINGSTON KC2500 1TB

★★★★★

£187 • [www.box.co.uk](http://www.box.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

It's worth paying a little

more for the KC2500's immense read and write speeds, which are maintained unusually well during more difficult transfer tasks.



CAPACITY 1TB • COST PER GIGABYTE £0.19p • INTERFACE M.2/NVMe • CLAIMED READ 3,500MB/s • CLAIMED WRITE 2,900MB/s • WARRANTY Five years RTB • DETAILS [www.kingston.com](http://www.kingston.com) • PART CODE SKC2500M8/1000G • FULL REVIEW Aug 2020

### KINGSTON A2000 1TB

★★★★★

£97 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

The A2000's maximum speeds don't

look all that hot, but this SSD performs exceptionally well in the kinds of non-sequential transfer tasks you're more likely to actually undertake in your day-to-day computing.



CAPACITY 1TB • COST PER GIGABYTE £0.10p • INTERFACE M.2/NVMe • CLAIMED READ 2,200MB/s • CLAIMED WRITE 2,000MB/s • WARRANTY Five years RTB • DETAILS [www.kingston.com](http://www.kingston.com) • PART CODE SA2000M8/1000G • FULL REVIEW Dec 2019



# Choosing an... Intel motherboard

**01** It's essential that you buy the right type of motherboard for your processor. For example, Intel's Skylake, Kaby Lake and Coffee Lake processors all use the same LGA 1151 socket, but because each CPU generation introduced new chipsets, you'll need to get a Z370 motherboard for a Coffee Lake chip, a Z270 board for a Kaby Lake chip and so on.

**02** All current Intel processors have built-in graphics chipsets, so if you want to use your chip's built-in graphics, make sure the motherboard has the video outputs, such as DVI, HDMI and DisplayPort. If you want to play the latest games, you'll need to fit a dedicated graphics card in the motherboard's PCI

Express x16 slot, although this may block one of your other slots.

**03** Normal tower cases can accommodate ATX motherboards, which provide the most expansion slots. A microATX motherboard will let you build your PC in a smaller case, but if you opt for a microATX board, make sure it has all the features you need built in as there won't be much room for expansion cards.

**04** If you want to install lots of expansion cards, look for a motherboard that offers plenty of PCI and PCI-E x1 slots. Some motherboards also have PCI Express x4 slots and extra PCI Express x16 slots. PCI Express x1 and x4

cards also work in PCI Express x16 slots. If you need a lot of storage, a motherboard with plenty of SATA2 and SATA3 ports is essential. SATA2 is fine for optical drives and hard disks, but to make the most of an SSD you need SATA3.

**05** All motherboards have built-in audio chipsets, but some support only 5.1 surround sound rather than 7.1. If you're connecting to older surround-sound amplifiers that don't have HDMI, look for an optical or coaxial S/PDIF output. All motherboards have Ethernet ports and most have the faster Gigabit version. You may also find it useful to buy a board with built-in Wi-Fi so you don't have to use up a USB port or PCI slot with an adaptor.

## COMPONENTS

### AMD Ryzen 9 3900X

★★★★★

£440 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

Forget the Intel Core i9-9900K – this 12-core monster of a CPU performs far better for similar money. There is a drawback, in that it's not very overclocking-friendly, but that's partly because it's so fast to begin with. Pair it with some good RAM, and you're already most of the way to a capable home workstation.

**SOCKET** AM4 • **CORES** 12 • **FREQUENCY** 3.8GHz • **INTEGRATED GRAPHICS** None • **WARRANTY** Two years RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** 100-100000023BOX • **FULL REVIEW** Nov 2019



### AMD Radeon RX 5700

★★★★★

£334 • [shop.amd.com](http://shop.amd.com)

**COMPUTER SHOPPER**  
BEST BUY

AMD's 7nm GPU is cheaper than the GeForce RTX 2060 and the RTX 2060 Super, yet is just as comfortable with gaming at 1080p and 1440p. This price only seems to apply for the reference design rather than partner versions, but the blower-style cooler is the only real downside.

**GPU** AMD Radeon RX 5700 • **MEMORY** 8GB GDDR6 • **GRAPHICS CARD LENGTH** 268mm • **WARRANTY** One year RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** Radeon RX 5700 • **FULL REVIEW** Oct 2019



### AMD Ryzen 7 3700X

★★★★★

£284 • [www.amzn.to/2nFtHMC](http://www.amzn.to/2nFtHMC)

**COMPUTER SHOPPER**  
BEST BUY

This octa-core chip has all the single-core strength of the Ryzen 9 3900X, with multitasking power that still puts it well beyond its Intel rivals. Low pricing and power efficiency are additional highlights: the Ryzen 7 3700X only draws up to 65W, a tiny amount for this many cores.

**SOCKET** AM4 • **CORES** 8 • **FREQUENCY** 3.6GHz • **INTEGRATED GRAPHICS** None • **WARRANTY** Two years RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** 100-100000071BOX • **FULL REVIEW** Dec 2019



### GIGABYTE Z490 Aorus Master

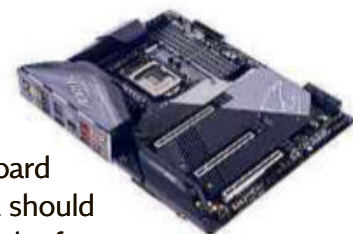
★★★★★

£375 • [www.ebuyer.com](http://www.ebuyer.com)

**COMPUTER SHOPPER**  
BEST BUY

If you can afford to splash out on a high-end motherboard for Intel's 10th-gen chips, it should be this one. The Z490 Aorus Master has all the features and overclocking capability of its rivals, and is better designed.

**PROCESSOR SOCKET** LGA 1200 • **DIMENSIONS** 305x244mm • **CHIPSET** Intel Z490 • **MEMORY SLOTS** 4 • **PCI-E x16 SLOTS** 3 • **PCI-E x1 SLOTS** 0 • **PCI SLOTS** 0 • **USB PORTS** 4x USB2, 2x USB3, 3x USB3.1, 1x USB Type-C • **VIDEO OUTPUTS** 1x HDMI • **WARRANTY** One year RTB • **DETAILS** [www.gigabyte.com](http://www.gigabyte.com) • **PART CODE** Z490 Aorus Master • **FULL REVIEW** Oct 2020



### ASUS ROG Strix Flare

★★★★★

£153 • [www.novatech.co.uk](http://www.novatech.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

Besides being a comfortable and responsive gaming keyboard, thanks to its reliable Cherry MX Red switches, the ROG Strix Flare is loaded with useful features and extras: there's a set of dedicated media controls and a USB2 pass-through port, among others.

**KEYBOARD SHAPE** Full size • **NUMBER PAD** Yes • **CONNECTION** 1x USB2 • **MEDIA KEYS** Pause/play, mute, skip, volume • **USB PORTS** 2x USB2 • **WARRANTY** One year RTB • **DETAILS** [www.asus.com/uk](http://www.asus.com/uk) • **PART CODE** 90MP000MO-BOEA00 • **FULL REVIEW** Oct 2019



### NZXT Kraken X53

★★★★★

£120 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

Not only is the Kraken X53 one of the most effective AIO watercoolers out there, it's also among the easiest to install and the easiest to customise.

It works with lots of different Intel and AMD sockets too, so you can upgrade older PC builds as well as newer ones.

**TECHNOLOGY** Closed loop • **FANS** 2x 120mm • **SOCKET** Intel LGA 2066/2011-3/2011/1151/1150/1155/1156/1366, AMD AM4/TR4 (TR4 requires separate bracket) • **RADIATOR DIMENSIONS (NO FAN)** 123x275x30mm • **WARRANTY** Six years RTB • **DETAILS** [www.nzxt.com](http://www.nzxt.com) • **PART CODE** RL-KRX53-01 • **FULL REVIEW** May 2020





# Choosing a... Custom PC spec

**01** Building your own PC is often cheaper than buying a pre-made system, and gives full control over the components. You don't need any special computer knowledge: just a few spare hours, a screwdriver and your choice of parts. Even things such as liquid-cooling systems can be found in user-friendly, easy-to-install packages, and for the most part it's as simple as inserting each component into a particular slot.

**02** Arguably the most important component is the CPU. These days you can get a quad-core chip even on a tight budget, which should provide more than enough brainpower for simple tasks such as web browsing, but hexa-core and octa-core chips are better for tougher jobs such as media editing, gaming and content creation.

The CPU will also determine which motherboards you can choose from. Intel CPUs will only work with boards that use an Intel chipset, like Z390, Z370 and B360, while AMD processors need AMD chipsets, such as X470 and B450.

**03** When choosing a motherboard, think about both the size of the PC's chassis (smaller cases won't fit larger ATX or EATX boards, for instance) and how many

additional components you'll want to install. For systems with a lot of expansion cards (such as graphics cards, sound cards or Wi-Fi cards), it's best to go with ATX motherboards and larger. For simpler builds, microATX or Mini-ITX boards could well provide all the connectivity you need. Keep in mind, too, that if you want to try overclocking, only certain Intel chipsets will support it, such as Z370 and Z390. AMD is more relaxed, enabling overclocking on all its Ryzen-compatible chipsets, except A320 and A300.

**04** While CPU integrated graphics will suffice for everyday browsing, a dedicated graphics card is essential for high-quality gaming. These can be installed in a PCI-E x16 slot on your motherboard, and have the bonus of adding more display outputs to use – just make sure the card will fit inside your chosen case.

**05** On the subject of cases, personal taste will factor highly here: nobody wants an ugly PC. That said, picking a chassis with adequate space for components is vital. As already mentioned, an ATX motherboard likely won't fit in a mini-tower case, and if you want to install a lot of hard disks, you'll need a case with sufficient drive bays.

**06** Every PC requires RAM and a PSU. Performance doesn't vary much between specific models, but generally you should aim for 8GB of RAM for a basic build and 16GB for higher-end systems, and at least a 550W, Bronze-certified PSU. It's better to buy a higher-wattage PSU than you strictly need, as it will allow you to add more components in the future. Also, check which RAM is compatible with your motherboard before buying, although for all current models it's probably going to be DDR4.

**07** Our recommended storage setup comprises both an SSD and a larger mechanical hard disk. By installing Windows (and a few choice applications) on the SSD, you can ensure fast booting and loading times, while the HDD is a cost-effective way of storing lots of files. Alternatively, you could buy a hard disk, and then install an Intel Optane Memory module to accelerate its write speeds to SSD levels, although since SSDs are barely more expensive than Optane drives, this is perhaps better for situations when you want to upgrade from an existing hard disk, rather than when you're building a whole new system. In the latter case, an SSD/HDD combo is better all round. See page 58 for our recommended storage drives.

## BUDGET PCs

### AMD Athlon 3000G

★★★★★

£45 • [www.scan.co.uk](http://www.scan.co.uk)



All eyes have been on Ryzen recently, but the Athlon 3000G is a nifty little dual-core chip: it has integrated graphics, ideal for basic builds, and unlike most budget CPUs, it's unlocked for overclocking. It's not tremendously fast, relatively speaking, but for this little cash, it's a terrific deal.



**SOCKET** AM4 • **CORES** 2 • **FREQUENCY** 3.5GHz • **INTEGRATED GRAPHICS** AMD Radeon RX Vega 3 • **WARRANTY** Two years RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** YD3000C6FHBOX • **FULL REVIEW** Mar 2020

### ASROCK Fatal1ty AB350 Gaming-ITX/ac

★★★★★

£137 • [www.amzn.to/36aek0H](http://www.amzn.to/36aek0H)



Tiny it may be, but the AB350 makes the most of what space it has available. Multiple display outputs, a rear-mounted M.2 port and onboard Wi-Fi mean it almost has the specs of a respectable ATX model.



**PROCESSOR SOCKET** AM4 • **DIMENSIONS** 170x170mm • **CHIPSET** AMD B350 • **MEMORY SLOTS** 2 • **PCI-E X16 SLOTS** 1 • **PCI-E X1 SLOTS** 0 • **PCI SLOTS** 0 • **USB PORTS** 2x USB2, 2x USB3, 1x USB Type-C • **VIDEO OUTPUTS** 2x HDMI • **WARRANTY** One year RTB • **DETAILS** [www.asrock.com](http://www.asrock.com) • **PART CODE** 90-MXB5P0-A0UAYZ • **FULL REVIEW** Jul 2018

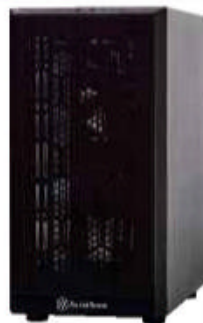
### SILVERSTONE Precision Series PS15

★★★★★

£45 • [www.scan.co.uk](http://www.scan.co.uk)



As long as you work within its limit as a microATX chassis, the PS15 is a great fit for budget builds. Despite costing a pittance, it's well designed and can take a multitude of fans and radiators, so all-in-one watercooling is a possibility for future upgrades.



**CASE TYPE** Mini tower • **MOTHERBOARD TYPE** MicroATX, Mini-ITX • **SUPPLIED FANS** 1x 120mm • **MAXIMUM DRIVE BAYS** 1x 3.5in, 3x 2.5in • **DIMENSIONS** 381x192x351mm • **WEIGHT** 3.5kg • **WARRANTY** One year RTB • **DETAILS** [www.silverstonetk.com](http://www.silverstonetk.com) • **PART CODE** SST-PS15B-G • **FULL REVIEW** Aug 2019

### ASUS ROG Strix RX 570 OC

★★★★★

£145 • [www.scan.co.uk](http://www.scan.co.uk)



Although this is an older GPU, it's cheaper than a lot of the more recent 'budget' cards and, crucially, more powerful, too. It therefore comes highly recommended if you want to take a step up from integrated graphics without having to spend much.



**GPU** AMD Radeon RX 570 • **MEMORY** 4GB GDDR5 • **GRAPHICS CARD LENGTH** 240mm • **WARRANTY** Two years repair and replace • **DETAILS** [www.asus.com](http://www.asus.com) • **PART CODE** ROG-STRIX-RX570-O4G-GAMING • **FULL REVIEW** Jan 2020



## MID-RANGE PCs

### INTEL Core i5-10600K

★★★★★

£251 • [www.ebuyer.com](http://www.ebuyer.com)

**COMPUTER SHOPPER**  
RECOMMENDED

This chip is not as cheap as AMD's equivalents, nor as efficient at multitasking, but it's still a very quick, highly overclockable hexa-core CPU with gaming performance that beats some top-of-the-range enthusiast processors.



**SOCKET** Intel LGA 1200 • **CORES** 6 • **FREQUENCY** 4.1GHz • **INTEGRATED GRAPHICS** Intel UHD Graphics 630 • **WARRANTY** Three years RTB • **DETAILS** [www.intel.com](http://www.intel.com) • **PART CODE** BX8070110600K • **FULL REVIEW** Aug 2020

### NZXT Kraken X53

★★★★★

£120 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

Not only is the Kraken X53 one of the most effective AIO watercoolers out there, it's also among the easiest to install and the easiest to customise. It works with loads of different Intel and AMD sockets too, so can upgrade older PC builds as well as newer ones.



**TECHNOLOGY** Closed loop • **FANS** 2x 120mm • **SOCKET** Intel LGA 2066/2011-3/2011/1151/1150/1155/1156/1366, AMD AM4/TR4 (TR4 requires separate bracket) • **RADIATOR DIMENSIONS (NO FAN)** 123x275x30mm • **WARRANTY** Six years RTB • **DETAILS** [www.nzxt.com](http://www.nzxt.com) • **PART CODE** RL-KRX53-01 • **FULL REVIEW** May 2020

### AMD Radeon RX 5700

★★★★★

£334 • [shop.amd.com](http://shop.amd.com)

**COMPUTER SHOPPER**  
BEST BUY

AMD's 7nm GPU is cheaper than both the GeForce RTX 2060 and the RTX 2060 Super, yet is just as comfortable with gaming at 1080p and 1440p. This low price only seems to apply for the reference design rather than partner versions, but the blower-style cooler is the only real downside.



**GPU** AMD Radeon RX 5700 • **MEMORY** 8GB GDDR6 • **GRAPHICS CARD LENGTH** 268mm • **WARRANTY** One year RTB • **DETAILS** [www.amd.com/uk](http://www.amd.com/uk) • **PART CODE** Radeon RX 5700 • **FULL REVIEW** Oct 2019

### COOLER MASTER MasterBox K500

★★★★★

£70 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

Great looks, a full set of pre-installed fans, high build quality and a spacious interior: the MasterBox K500 is a commendable all-rounder. It's not the best on storage capacity, but you can still add at least a couple of SSDs and hard disks each.



**CASE TYPE** Mid-tower • **MOTHERBOARD TYPE** ATX, microATX, Mini-ITX • **SUPPLIED FANS** 3x 120mm • **MAX DRIVE BAYS** 3x 3.5in, 2x 2.5in • **DIMENSIONS** 260xx190x280mm • **WEIGHT** 6.2kg • **WARRANTY** Two years RTB • **DETAILS** [www.coolermaster.com](http://www.coolermaster.com) • **PART CODE** MCB-K500D-KGNN-S00 • **FULL REVIEW** Jan 2019

## PREMIUM PCs

### AMD Ryzen 9 3900X

★★★★★

£440 • [www.ebuyer.com](http://www.ebuyer.com)

**COMPUTER SHOPPER**  
RECOMMENDED

Forget the Intel Core i9-9900K – this 12-core monster of a CPU performs far better for similar money. There is a drawback, in that it's not very overclocking-friendly, but that's partly because it's so fast to begin with. Pair it with some good RAM, and you're already most of the way to a capable home workstation.



**SOCKET** AM4 • **CORES** 12 • **FREQUENCY** 3.8GHz • **INTEGRATED GRAPHICS** None • **WARRANTY** Two years RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** 100-100000023BOX • **FULL REVIEW** Nov 2019

### ASUS ROG Strix Flare

★★★★★

£153 • [www.novatech.co.uk](http://www.novatech.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

Besides being a comfortable and responsive gaming keyboard, largely thanks to its always-reliable Cherry MX Red switches, the ROG Strix Flare is loaded with useful features and cool extras: there's a set of dedicated media controls and a USB2 pass-through port, among others.



**KEYBOARD SHAPE** Full size • **NUMBER PAD** Yes • **CONNECTION** 2xUSB2 • **MEDIA KEYS** Pause/play, mute, skip, volume • **USB PORTS** 2x USB2 • **WARRANTY** One year RTB • **DETAILS** [www.asus.com/uk](http://www.asus.com/uk) • **PART CODE** 90MP000MO-BOEA00 • **FULL REVIEW** Oct 2019

### THERMALTAKE View 37

★★★★★

£130 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

A spacious, feature-rich chassis for both ATX- and EATX-based builds, the View 37 comes with a gull-wing side window that's perfect for showing off your handiwork.



**CASE TYPE** Mid-tower • **MOTHERBOARD TYPE** ATX, EATX, microATX, Mini-ITX • **SUPPLIED FANS** 2x 140mm • **MAXIMUM DRIVE BAYS** 7x 3.5in, 11x 2.5in • **DIMENSIONS** 525x261x538mm • **WEIGHT** 11.8kg • **WARRANTY** Three years RTB • **DETAILS** [www.thermaltake.com](http://www.thermaltake.com) • **PART CODE** CA-1J7-00M1WN-00 • **FULL REVIEW** Dec 2018

### AMD Radeon RX 5700 XT

★★★★★

£379 • [shop.amd.com](http://shop.amd.com)

**COMPUTER SHOPPER**  
RECOMMENDED

The standard RX 5700 is better value for lower resolutions, but if you want to play at 4K without the expense of Nvidia's top RTX graphics cards, the RX 5700 XT's higher core count and clock speeds make it a great choice.



**GPU** AMD Radeon RX 5700 XT • **MEMORY** 8GB GDDR6 • **GRAPHICS CARD LENGTH** 272mm • **WARRANTY** One year RTB • **DETAILS** [www.amd.com/uk](http://www.amd.com/uk) • **PART CODE** Radeon RX 5700 XT • **FULL REVIEW** Oct 2019



# Choosing a... Display

**01** A basic 24in LCD monitor costs around £100. It will be fine for typical Windows work but is likely to have poor viewing angles, so you'll need to sit straight on for the best picture quality. Its colour accuracy may not be very good, either.

**02** A VGA input lets you use the monitor with any PC, but the quality may not be as good as it is over DVI or HDMI. Both are digital connections and require a compatible graphics card but they avoid the need for digital-to-analogue or analogue-to-digital conversions, which can reduce image quality. A digital connection achieves the best picture automatically, so you won't have to adjust clock or phase settings as you do with analogue connections.

Many DVI and all HDMI connections support HDCP, which lets you watch protected video content, such as Blu-ray movies. DisplayPort is becoming more popular, but you'll need a graphics card with a DisplayPort output (mini or full-size) to use this input on your monitor.

**03** A larger monitor will be easier on the eye and may have a higher resolution. Most monitors have a resolution of at least 1,920x1,080 (1080p), which provides lots of room for working with multiple windows at the same time. For even higher resolutions, you'll need a larger display. Some 27in and 30in screens have 2,560x1,600 or even 4K resolutions. You'll need a graphics card with a dual-link DVI output and a dual-link DVI

cable or either HDMI or DisplayPort to use a monitor at these resolutions.

**04** If you want better picture quality, look for a monitor with a high contrast ratio. The higher the ratio, the whiter the whites and the blacker the blacks. You'll also be able to see more fine detail in images with high contrast levels. Viewing angles are important, as wider angles mean you don't have to sit directly in front of the monitor to get the best picture. Wider viewing angles also allow more people to view the screen at the same time.

Fast response times reduce ghosting, but don't be dazzled by the numbers. A response time of 25ms or quicker is fine for all applications.

## DISPLAYS

### LG 27GL850

★★★★★

£439 • [www.currys.co.uk](http://www.currys.co.uk)



This monitor's size and resolution hit the sweet spot for serious gaming, and it's helped further by both G-Sync and FreeSync support, as well as an innovative IPS panel that's faster and more responsive than the technology usually is.



SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • REFRESH RATE 144Hz • SCREEN TECHNOLOGY IPS • VIDEO INPUTS HDMI, DisplayPort • WARRANTY One year parts and labour • DETAILS [www.lg.com](http://www.lg.com) • PART CODE 27GL850-B • FULL REVIEW Oct 2020

### LENOVO

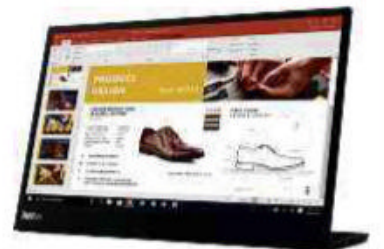
### ThinkVision M14

★★★★★

£228 • [business.currys.co.uk](http://business.currys.co.uk)



With the ThinkVision M14, portable USB Type-C monitors finally reach maturity. It's razor-thin, has an adjustable hinge instead of a fixed angle, and its IPS panel is leagues ahead of the competition.



SCREEN SIZE 14in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS USB Type-C • WARRANTY Three years RTB • DETAILS [www.lenovo.com](http://www.lenovo.com) • PART CODE D18140FX0 • FULL REVIEW Mar 2020

### AOC 24B2XH

★★★★★

£105 • [www.uk.insight.com](http://www.uk.insight.com)



IPS monitors don't come any cheaper than this, and the AOC 24B2XH backs up this initial promise with vibrant onscreen tones, excellent colour accuracy and even good contrast – something even expensive IPS panels can struggle with.



SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • REFRESH RATE 75Hz • VIDEO INPUTS HDMI, VGA • WARRANTY Three years RTB • DETAILS [eu.aoc.com](http://eu.aoc.com) • PART CODE: 24B2XH • FULL REVIEW Sep 2020

### AOC CQ32G1

★★★★★

£320 • [www.ballicom.co.uk](http://www.ballicom.co.uk)



AOC has a habit of making great-value, large-screened VA monitors, and the CQ32G1 is another to add to the list. A 144Hz gaming display first and foremost, it's as fast and good-looking as it needs to be, and supports both AMD FreeSync and, unofficially, Nvidia G-Sync.



SCREEN SIZE 31.5in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY VA • REFRESH RATE 144Hz • VIDEO INPUTS HDMI, DisplayPort • WARRANTY One year repair and replace • DETAILS [eu.aoc.com](http://eu.aoc.com) • FULL REVIEW Nov 2019

### ACER Nitro VG270UP

★★★★★

£337 • [www.amzn.to/3iCjVSR](http://www.amzn.to/3iCjVSR)



A great all-round gaming monitor without the premium price. Both FreeSync and G-Sync are supported, and the IPS panel combines a 144Hz refresh rate with vibrant colours, high accuracy and the kind of responsiveness you'd normally only get from a TN panel.



SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • REFRESH RATE 144Hz • VIDEO INPUTS HDMI, DisplayPort • WARRANTY Two years RTB • DETAILS [www.acer.com](http://www.acer.com) • FULL REVIEW Dec 2019

### Iiyama ProLite XUB2792UHSU

★★★★★

£335 • [www.scan.co.uk](http://www.scan.co.uk)



If you don't need all the bells and whistles of a curved ultrawide, the ProLite XUB2792UHSU nails the basics at a very attractive price. 4K sharpness, high brightness and full sRGB colour gamut coverage add up to a superb monitor.



SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS DisplayPort, HDMI, DVI • WARRANTY Three years onsite • DETAILS [www.iiyama.com](http://www.iiyama.com) • FULL REVIEW Nov 2019



# Choosing a... Laser printer

**01** Laser printers used to be much more expensive than inkjets and were typically restricted to offices. They are now much more affordable, however, and offer several benefits over inkjets, including lower per-page printing costs and faster print speeds.

**02** A decent laser printer will typically cost around £80, and will happily print hundreds of black-and-white pages per hour. If documents are your priority, you'll want a high minimum speed and low print costs. However, you'll probably be limited to black-and-white printing at this price.

**03** Although you can still buy single-function laser printers, multifunction

peripherals (MFPs) are now far more common. These models can scan and photocopy documents as well as print them, and some of them also have fax capabilities. Laser MFPs start from around £200.

**04** Heavy-duty office lasers designed for printing thousands of pages per month can cost thousands of pounds. They use large individual toner drums, which can cut running costs. Automatic duplex (double-sided) printing is also common here.

**05** Although laser printers are more suited to printing text than graphics, many are still able to produce high-quality photographs. Speed isn't a priority here – instead choose a printer that reproduces

subtle tones well. You can't determine this by looking at the specifications; only hands-on testing will do, so remember to check our reviews before you buy. Borderless printing (up to the edge of the paper) should also be possible.

**06** If you want to print from multiple devices, make sure you look for extended connectivity. Decent laser printers can be shared on your local network and have USB ports for direct printing, memory card slots for printing images from a digital camera, and iOS, Android or Google Cloud Print support for printing from mobile devices such as smartphones or tablets. An LCD preview screen offers greater control for this method of printing.

## PRINTERS & SCANNERS

### EPSON WorkForce WF-110W

★★★★★

£206 • [www.printerbase.co.uk](http://www.printerbase.co.uk)



**COMPUTER SHOPPER**  
RECOMMENDED

Low speeds and high running costs are usually a ruinous combination, but the WF-110W makes up for its shortcomings with a nicely portable design and high print quality.

**TECHNOLOGY** Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 5,760x1,440dpi • **DIMENSIONS** 61x309x159mm • **WEIGHT** 1.6kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** [www.epson.co.uk](http://www.epson.co.uk) • **PART CODE** C11CH25401DA • **FULL REVIEW** Apr 2020

### BROTHER MFC-J1300DW All in Box

★★★★★

£316 • [www.printerbase.co.uk](http://www.printerbase.co.uk)



**COMPUTER SHOPPER**  
RECOMMENDED

Its grey plastic build doesn't give the best first impression, but the MFC-J1300DW All in Box is a deceptively feature-rich yet easy-to-use MFP for busy home offices. Its running costs are low, too.

**TECHNOLOGY** Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 6,000x1,200dpi • **SCANNER RESOLUTION** 1,200x2,400dpi • **DIMENSIONS** 195x435x341mm • **WEIGHT** 8kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** Three years RTB • **DETAILS** [www.brother.co.uk](http://www.brother.co.uk) • **PART CODE** MFCJ1300DWZU1 • **FULL REVIEW** Sep 2020

### EPSON Expression Photo XP-8600

★★★★★

£90 • [www.argos.co.uk](http://www.argos.co.uk)



**COMPUTER SHOPPER**  
BEST BUY

The Expression Photo XP-8600 focuses on creative use, and does a great job of it, too. At this kind of price, nothing else comes close on the quality of printed photos.

**TECHNOLOGY** Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 5,760x1,440dpi • **SCANNER RESOLUTION** 1,200x4,800dpi • **DIMENSIONS** 142x349x340mm • **WEIGHT** 6.7kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** [www.epson.co.uk](http://www.epson.co.uk) • **PART CODE** C11CH47401 • **FULL REVIEW** Jan 2020

### CANON Pixma TS205

★★★★★

£30 • [store.canon.co.uk](http://store.canon.co.uk)



**COMPUTER SHOPPER**  
RECOMMENDED

It has a basic feature set and isn't very fast, but the Pixma TS205's print quality makes it a bargain. Replacement ink cartridges are the biggest expense, but that's fine if you're only printing at home occasionally.

**TECHNOLOGY** Thermal inkjet • **MAXIMUM PRINT RESOLUTION** 4,800x1,200dpi • **DIMENSIONS** 131x426x255mm • **WEIGHT** 2.5kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** [www.canon.co.uk](http://www.canon.co.uk) • **PART CODE** 2319C008 • **FULL REVIEW** Sep 2019

### CANON imageFormula DR-C230

★★★★★

£324 • [www.printerbase.co.uk](http://www.printerbase.co.uk)



**COMPUTER SHOPPER**  
RECOMMENDED

This sheet-fed document scanner is perfect for getting through stacks of documents without having to manually scan each page. It's pleasantly fast and pairs with Canon's powerful CaptureOnTouch Pro software, which does a fine job of processing your scans.

**TECHNOLOGY** Dual CIS sheet-fed scanner • **SCANNER RESOLUTION** 600x600dpi • **DIMENSIONS** 231x291x530mm • **WEIGHT** 2.8kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** [www.canon.co.uk](http://www.canon.co.uk) • **PART CODE** 2646C003 • **FULL REVIEW** Feb 2018

### HP Neverstop Laser 1202nw

★★★★★

£261 • [store.hp.com](http://store.hp.com)



**COMPUTER SHOPPER**  
BEST BUY

Unbelievably low running costs transform the Neverstop Laser 1202nw from a fairly humdrum mono MFP into an excellent choice for those who need bulk printing.

**TECHNOLOGY** Mono laser • **MAXIMUM PRINT RESOLUTION** 5,760x1,440 • **SCANNER RESOLUTION** 600x600dpi • **DIMENSIONS** 287x381x294mm • **WEIGHT** 8.8kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** Three years RTB with registration • **DETAILS** [www.hp.co.uk](http://www.hp.co.uk) • **PART CODE** 5HG93A#B19 • **FULL REVIEW** Aug 2020



# Choosing a... Wireless router

**01** Wireless routers each use a number of Wi-Fi standards, so you shouldn't have any trouble connecting your computer or phone wirelessly if you get an 802.11n or 802.11ac router. Nearly all routers support 802.11n, so even a cheap model should provide decent performance.

You can expect a transfer speed of around 40Mbit/s at a distance of 10m from any modern 802.11n router. The very latest routers use the 802.11ac standard, which provides tremendously fast transfer speeds. Some devices still don't support the 802.11ac standard, so check the specifications before you buy.

**02** If you subscribe to an ADSL broadband service, you should buy

a wireless router that has a built-in ADSL modem. This will cost more than the equivalent cable router, but it allows you to connect your router directly to your broadband connection without having to use a separate modem.

**03** Most 802.11n wireless routers use the 2.4GHz frequency band. This has good range but it can be prone to interference if it's positioned close to a lot of other 2.4GHz devices, such as other routers and baby monitors. If you have trouble getting a consistent signal or you want faster speeds for video streaming, for example, it's worth buying a dual-band router that can use both the 2.4GHz and 5GHz bands.

Alternatively, a high-gain antenna can boost signals and improve ranges and throughputs to the entire house. You can also add a high-gain antenna to a PC's network adaptor. If wired network speeds are a priority, you should look for a router with a Gigabit Ethernet connection.

**04** Many routers come with built-in USB ports that let you connect a USB drive and use the router as a network storage device. If you want to share a USB printer over your network, look for a wireless router that has a USB print server.

Finally, if you're interested in making voice calls over the internet, buy a router with built-in VoIP support (and phone sockets) because this can save you money.

## NETWORKS

### BT Complete Wi-Fi

★★★★★

£5 per month • [www.bt.com](http://www.bt.com)

**COMPUTER SHOPPER**  
RECOMMENDED

There are better-featured mesh systems available, but the Complete Wi-Fi is decently quick on both the 5GHz and 2.4GHz bands, and is well worth it for BT Plus customers in particular.

**WI-FI STANDARD** 802.11ac • **STATED SPEED** 1,733Mbit/s (5GHz), 385Mbit/s (2.4GHz) • **USB PORTS** 1 • **WALL MOUNTABLE** No • **WARRANTY** Under rental contract • **PART CODE** BT Complete Wi-Fi • **FULL REVIEW** Mar 2019



### GOOGLE Nest WiFi

★★★★★

£239 • [store.google.com](http://store.google.com)

**COMPUTER SHOPPER**  
RECOMMENDED

This mesh system is a little different: its satellites are also Google Assistant speakers, adding some neat smart home functionality throughout your house.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** Not stated • **USB PORTS** None • **WALL MOUNTABLE** No • **WARRANTY** Two years RTB • **PART CODE** Nest WiFi • **FULL REVIEW** Aug 2020



### TP-LINK Deco X60

★★★★★

£413 • [www.tp-link.com](http://www.tp-link.com)

**COMPUTER SHOPPER**  
RECOMMENDED

At nearly half the price of some equivalent Wi-Fi 6 mesh systems, the TP-Link Deco X60 is a great option for those who want the latest wireless technology without breaking the bank.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ax • **STATED SPEED** 2,404Mbit/s (5GHz), 574Mbit/s (2.4GHz) • **USB PORTS** None • **WALL MOUNTABLE** No • **WARRANTY** Two years RTB • **PART CODE** Deco X60 • **FULL REVIEW** Sep 2020



### NETGEAR Nighthawk AX8

★★★★★

£300 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

If you want to get in early on Wi-Fi 6/802.11ax, this is a good router to do it with. It's no more difficult to set up than an 802.11ac model, but successfully delivers the newer standard's higher speeds.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ax • **STATED SPEED** 4,800Mbit/s (5GHz), 1,200Mbit/s (2.4GHz) • **USB PORTS** 2 • **WALL MOUNTABLE** Yes • **WARRANTY** Two years RTB • **DETAILS** [www.netgear.com](http://www.netgear.com) • **PART CODE** RAX80 • **FULL REVIEW** Jan 2020



### D-LINK DIR-1960

★★★★★

£104 • [www.amzn.to/2Tj1zf5](http://www.amzn.to/2Tj1zf5)

**COMPUTER SHOPPER**  
BEST BUY

The DIR-1960 is a simple yet speedy router that can optionally be turned into a mesh system (provided you buy the additional satellites, of course). Either way, you can also take advantage of built-in Alexa and Google Assistant controls.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** 1,300Mbit/s (5GHz), 600Mbit/s (2.4GHz) • **USB PORTS** 1x USB2 • **WALL MOUNTABLE** Yes • **WARRANTY** Two years RTB • **DETAILS** [www.d-link.com](http://www.d-link.com) • **PART CODE** DIR-1960 • **FULL REVIEW** Nov 2019



### NETGEAR Orbi Outdoor RBS50Y

★★★★★

£275 • [www.broadbandbuyer.com](http://www.broadbandbuyer.com)

**COMPUTER SHOPPER**  
RECOMMENDED

This weatherproof Wi-Fi extender is a perfect addition to mesh systems that can't quite cover a garden. It has similar internal specifications to the brilliant Orbi RBK50, meaning high speeds and reliable connections.

**WI-FI STANDARD** 802.11ac • **STATED SPEED** 1x 866Mbit/s (5GHz) 1x 1,733Mbit/s (5GHz), 1x 400Mbit/s (2.4GHz) • **USB PORTS** 0 • **WALL MOUNTABLE** Yes • **WARRANTY** Two years RTB • **DETAILS** [www.netgear.co.uk](http://www.netgear.co.uk) • **PART CODE** RBS50Y • **FULL REVIEW** Jul 2019





# Choosing a... Smart thermostat

**01** A smart thermostat can save you a lot of money by intelligently controlling your heating.

Most smart heating devices are designed to be used with hot water central heating systems, with the boiler directly controlled by the system. These typically require a relay to be wired into your boiler, with a wireless thermostat giving you direct control. Smartphone apps then tie into the system to give you remote control. While it's possible to fit controls yourself, you may want to pay an experienced plumber to do the job: expect to pay around £150 for a typical installation.

If you have electric heating, there are very few choices, and the big names (Nest, Honeywell and so on) do not directly support these systems.

**02** Want smart hot water control? If you want to remotely set schedules and disable hot water while you're away, choose your smart system carefully, as many don't have this option. Hot water control usually requires a second relay to be wired into the boiler.

**03** What kind of heating system do you want? There are two main choices: a central system and one with individual radiator controls. The former replaces your existing thermostat, and lets you set one temperature for your entire house. The latter requires each radiator valve to be replaced with a smart valve so that each room and radiator can have its own individual control.

This option is more expensive to install but will provide you with greater savings.

**04** Do you use a smart personal assistant? Make sure that your smart thermostat supports the one that you use. Amazon Alexa, powered by the Echo and Echo Dot, is the best-supported system; Apple's HomeKit, powered by Siri, isn't so well supported; Google Assistant, built into Google Home, is just gaining traction and supports Nest only.

**05** If you want your smart heating system to do more, look for IFTTT support. With this handy system, you can set automatic rules, such as turning the heating off if the outside temperature rises.

## SMART HOME

### AMAZON Echo Dot with Clock

★★★★★

£35 • [www.amzn.to/2LLc9aG](http://www.amzn.to/2LLc9aG)

**COMPUTER SHOPPER**  
BEST BUY

This is literally 'just' an Echo Dot 3rd Generation with an added LCD clock, but considering it's no more expensive and offers the same combination of capable speaker and versatile smart home controller, that's absolutely nothing to complain about.



**DRIVERS** 1 • **RMS POWER OUTPUT** Not stated • **WEIGHT** 300g • **NETWORKING** Bluetooth, 802.11n • **WARRANTY** One year RTB • **DETAILS** [www.amazon.co.uk](http://www.amazon.co.uk) • **PART CODE** Echo Dot with Clock • **FULL REVIEW** Feb 2020

### NEST Cam IQ Outdoor

★★★★★

£329 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
RECOMMENDED

While this is an expensive replacement for the old Nest Cam Outdoor, its image quality is without equal. Facial and sound recognition have also been improved, and it's now much harder for thieves to remove the camera from its mount.



**VIDEO RESOLUTION** 4K sensor, 1080p recording • **CLOUD STORAGE** Yes (subscription required) • **NETWORKING** 802.11ac • **WARRANTY** One year RTB • **PART CODE** Nest Cam IQ Outdoor • **FULL REVIEW** Jul 2018

### TADO Smart Thermostat

★★★★★

£130 • [www.amzn.to/2ZxwlfZ](http://www.amzn.to/2ZxwlfZ)

**COMPUTER SHOPPER**  
BEST BUY

A flexible and stylish-looking smart heating system, the Tado Smart Thermostat distinguishes itself with a clever geolocation feature that turns on your heating when you enter a room and switches it off, saving money, when you leave.



**REMOTE THERMOSTAT** Yes • **HOT WATER SUPPORT** Yes • **INDIVIDUAL RADIATOR CONTROL** Yes • **VOICE ASSISTANT SUPPORT** Alexa, Google Assistant, Siri • **APPS** iOS, Android and web • **FULL REVIEW** Jan 2018

### NEOS Smartcam

★★★★★

£30 • [shop.neos.co.uk](http://shop.neos.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

The Smartcam is a tremendous bargain of an indoor security camera. In many ways, it's not all that advanced – footage is only shot at up to 15fps, for instance – but the 1080p resolution, night-vision mode and free cloud storage make for a nifty little package.



**VIDEO RESOLUTION** 1080p • **CLOUD STORAGE** Yes (free) • **NETWORKING** 802.11n • **WARRANTY** One year RTB • **PART CODE** NS-CAM-02 • **FULL REVIEW** Jun 2019

### GOOGLE Nest Hub Max

★★★★★

£219 • [store.google.com](http://store.google.com)

**COMPUTER SHOPPER**  
BEST BUY

Besides the addition of a camera – which can be turned off – this is mainly just a larger Google Home Hub. Luckily, that also means it's a fantastic smart display, with a higher resolution and better-sounding speaker.



**DRIVERS** 3 • **RMS POWER OUTPUT** Not stated • **DOCK CONNECTOR** None • **WIRELESS** 802.11ac Wi-Fi, Bluetooth 5.0 • **DIMENSIONS** 183x250x101mm • **WEIGHT** 1.3kg • **WARRANTY** One year RTB • **PART CODE** Nest Hub Max • **FULL REVIEW** Jan 2020

### RING Indoor Cam

★★★★★

£49 • [www.amzn.to/2P1RbGj](http://www.amzn.to/2P1RbGj)

**COMPUTER SHOPPER**  
BEST BUY

The Indoor Cam doesn't just capture very high-quality footage for the money. With its Modes feature, you can easily activate the camera when you leave home and deactivate it when you return. It's a smart blend of security and privacy.



**VIDEO RESOLUTION** 1080p • **CLOUD STORAGE** Yes • **NETWORKING** 802.11n • **WARRANTY** One year RTB • **PART CODE** Ring Indoor Cam • **FULL REVIEW** Apr 2020



# Choosing a... Smartphone

**01** A smartphone's operating system (OS) dictates its basic features and which third-party software you can install. There are three main contenders: Apple's iOS, which is found on the iPhone, Google's Android, which is used by various handset manufacturers, and Windows Phone, which has few options, especially since Microsoft has discontinued support for its OS. Apple iOS and Google Android both have thousands of apps available.

**02** All smartphones have colour screens, but their resolutions vary. Basic models have 1,280x720 pixels, but text can be indistinct. Look for a display that has at least 1,920x1,080 pixels so it's easier to read text

and watch Full HD videos. Don't worry too much about built-in media players or Office document editors; you can always install apps to replace these with better versions later.

The image quality of smartphone cameras has improved tremendously in recent years, and resolutions have increased to as high as 20 megapixels.

**03** Very few modern smartphones have a physical keyboard for entering text; they almost exclusively use touchscreens now. Physical keyboards can aid heavy emailing, but today's touchscreen keyboards work just as well.

Android smartphones and iPhones running iOS 9 or above allow you to install

a variety of custom onscreen keyboards so you can find one that suits you.

**04** Be careful when choosing a contract. Look for one that includes a large data allowance if you want to use the internet regularly or you've set your phone to synchronise your contacts, calendar and email through online services.

Built-in Wi-Fi can help you avoid high data charges by connecting to the internet through wireless hotspots when you're out, or your router when you're at home. Android and iPhone handsets can operate as wireless hotspots, letting you connect your laptop to the web over your mobile data connection. There may be an extra charge for this.

## SMARTPHONES

### ONEPLUS 8

★★★★★

£549 SIM-free • [www.johnlewis.com](http://www.johnlewis.com)



It doesn't take any risks, but this is still a great improvement on the OnePlus 7T. Once again, OnePlus has provided flagship-quality hardware, from the 90Hz display to the sharp triple-lens camera, at a lower price.



**PROCESSOR** Octa-core 2.84GHz Qualcomm Snapdragon 865 • **SCREEN SIZE** 6.55in • **SCREEN RESOLUTION** 2,400x1,080 • **REAR CAMERAS** 48 megapixels, 16 megapixels, 2 megapixels • **STORAGE** 128GB • **WIRELESS DATA** 5G • **NFC** Yes • **DIMENSIONS** 160x73x8mm • **WEIGHT** 180g • **OPERATING SYSTEM** Android 10 • **WARRANTY** One year RTB • **DETAILS** [www.oneplus.com](http://www.oneplus.com) • **PART CODE** IN2013 • **FULL REVIEW** Aug 2020

### SAMSUNG Galaxy S20

★★★★★

£749 SIM-free; £46-per-month contract • [www.samsung.com](http://www.samsung.com) (SIM-free); [www.tescomobile.com](http://www.tescomobile.com) (contract)



While still a pricey smartphone, the standard Galaxy S20 is the cheapest of Samsung's flagship line-up. It has the same processor as – and similar design to – the S20+ and S20 Ultra, so it's the best value as well.



**PROCESSOR** Octa-core 2.73GHz Samsung Exynos 990 • **SCREEN SIZE** 6.2in • **SCREEN RESOLUTION** 3,200x1,440 • **REAR CAMERAS** 12 megapixels, 64 megapixels, 12 megapixels • **STORAGE** 128GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 152x69x7.9mm • **WEIGHT** 163g • **OPERATING SYSTEM** Android 10 • **WARRANTY** One year RTB • **DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk) • **PART CODE** SM-G980FLBDEUA • **FULL REVIEW** Jul 2020

### MOTOROLA Moto E6 Plus

★★★★★

£80 SIM-free; £9-per-month contract • [www.argos.co.uk](http://www.argos.co.uk) (SIM-free); [www.tescomobile.com](http://www.tescomobile.com) (contract)



There's plenty of smartphone here for the money, whether it's the spacious 6.1in display or the surprisingly high performance. It also has a removable back panel, so it's one of very few Android handsets for which you can use spare batteries.



**PROCESSOR** Octa-core 2GHz Mediatek Helio P22 • **SCREEN SIZE** 6.1in • **SCREEN RESOLUTION** 1,560x720 • **REAR CAMERAS** 13 megapixels, 2 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **NFC** No • **DIMENSIONS** 156x73x8.6mm • **WEIGHT** 150g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** [www.motorola.co.uk](http://www.motorola.co.uk) • **PART CODE** PAG0000GB • **FULL REVIEW** May 2020

### GOOGLE Pixel 4a

★★★★★

£349 SIM-free • [store.google.com](http://store.google.com)



Even with tough competition from the iPhone SE and OnePlus Nord, the Pixel 4a stands out as a brilliant mid-range smartphone. A big part of its appeal is the single-lens rear camera, which takes flagship-worthy shots in all manner of conditions.



**PROCESSOR** Quad-core 2.2GHz Qualcomm Snapdragon 730G • **SCREEN SIZE** 5.8in • **SCREEN RESOLUTION** 2,240x1,080 • **REAR CAMERA** 12.2 megapixels • **STORAGE** 128GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 144x68x8.2mm • **WEIGHT** 143g • **OPERATING SYSTEM** Android 10 • **WARRANTY** One year RTB • **DETAILS** [store.google.com](http://store.google.com) • **PART CODE** Pixel 4a • **FULL REVIEW** Nov 2020

### APPLE iPhone SE (2020)

★★★★★

£419 SIM-free; £19 up front plus £16-per-month contract • [www.apple.com/uk](http://www.apple.com/uk) (SIM-free); [www.three.co.uk](http://www.three.co.uk) (contract)



The updated iPhone SE cuts a familiar figure: on the outside, it's essentially an iPhone 8. On the inside, however, it's fitted with the same A13 Bionic processor as the iPhone 11 range, for performance that more than meets 2020 standards.



**PROCESSOR** Hexa-core 2.65GHz Apple A13 Bionic • **SCREEN SIZE** 4.7in • **SCREEN RESOLUTION** 1,334x750 • **REAR CAMERA** 12 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 138x67x7.3mm • **WEIGHT** 138g • **OPERATING SYSTEM** iOS 13 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** iPhone SE 2020 • **FULL REVIEW** Sep 2020

### APPLE iPhone 11

★★★★★

£729 SIM-free; £9 up front plus £51-per-month contract • [www.apple.com/uk](http://www.apple.com/uk) (SIM-free); [www.carphonewarehouse.com](http://www.carphonewarehouse.com)



The standard iPhone 11 is a slick and powerful smartphone. It has the same class-leading A13 Bionic chip as the iPhone 11 Pro, while costing hundreds of pounds less.



**PROCESSOR** Hexa-core 2.65GHz Apple A13 Bionic • **SCREEN SIZE** 6.1in • **SCREEN RESOLUTION** 1,792x828 • **REAR CAMERAS** 12 megapixels, 12 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 151x76x8.3mm • **WEIGHT** 194g • **OPERATING SYSTEM** iOS 13 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** iPhone 11 • **FULL REVIEW** Mar 2020



# Choosing a... Tablet

**01** All tablets rely on an operating system (OS) to run apps. You have three main choices: Apple's iOS, which runs on the iPad; Android, which Google licenses to various manufacturers; and Windows 10, which has become common in hybrid tablets and convertibles. If you own an Apple or Google smartphone, you can download your apps, music and so on to a tablet that runs the same OS, so it makes sense to stick with a compatible device.

**02** It's important to pick a tablet that has a good-quality, high-resolution screen. Many budget tablets have 1,280x800-resolution displays, but better tablets have Full HD 1,920x1,080 panels, and we're

starting to see tablets that have even higher screen resolutions. Some are as high as 2,560x1,600 or even 4K. Entry-level tablets typically use TN panels, which don't have particularly good viewing angles. The viewing angles of IPS panels are much better.

**03** If you want to listen to music, watch films and play games, make sure your tablet has plenty of storage. Many tablets come with 8GB or 16GB of internal storage, although some budget models have less. You'll typically pay more for a higher storage capacity. Many tablets also have microSD slots that let you add extra storage, although you won't find one on an iPad. This is a cheap way of boosting storage capacity.

**04** Tablets rarely include a SIM card slot. This means you'll have to rely on Wi-Fi to get online, although some tablets let you access the internet through your smartphone. If you want mobile access to the internet, look for 3G- and 4G-ready devices. These almost always cost more than Wi-Fi-only models, but they're great if you use your tablet while commuting or travelling.

**05** Your choice of tablet determines the apps you can use on it. You may find that some of the apps you want are available on iOS but not Android, and vice versa. Windows 10, meanwhile, runs traditional desktop applications.

## TABLETS

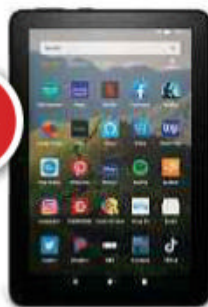
### AMAZON Fire HD 8 (2020)

★★★★★

£230 • [www.amzn.to/3c4ztfy](http://www.amzn.to/3c4ztfy)

**COMPUTER SHOPPER**  
BEST BUY

Amazon has crafted what might just be the best budget tablet around. It's outwardly similar to the previous Fire HD 8, but its faster processor, doubled RAM and new, faster-charging USB Type-C port make sizable improvements to what was already a great-value slate.



**PROCESSOR** Quad-core 2GHz MediaTek MT8168 • **SCREEN SIZE** 8in • **SCREEN RESOLUTION** 1,280x800 • **REAR CAMERA** 2 megapixels • **STORAGE** 8GB • **WIRELESS DATA** No • **DIMENSIONS** 202x137x9.7mm • **WEIGHT** 355g • **OPERATING SYSTEM** Fire OS • **WARRANTY** One year RTB • **DETAILS** [www.amazon.co.uk](http://www.amazon.co.uk) • **PART CODE** Fire HD 8 (2020) • **FULL REVIEW** Nov 2020

### APPLE iPad 10.2in

★★★★★

£343 • [www.amzn.to/32v58Ep](http://www.amzn.to/32v58Ep)

**COMPUTER SHOPPER**  
RECOMMENDED

After the previous iPad pivoted to an education focus, the latest model changes course again, aiming to become a more affordable 2-in-1 than the iPad Pro range. It works, too: the enlarged screen, Smart Connector for keyboards and high performance make for a relatively affordable laptop alternative.



**PROCESSOR** Quad-core Apple A10 Fusion • **SCREEN SIZE** 10.2in • **SCREEN RESOLUTION** 2,160x1,620 • **REAR CAMERA** 8 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G (cellular model) • **DIMENSIONS** 215x174x7.5mm • **WEIGHT** 483g • **OPERATING SYSTEM** iPadOS • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** iPad (2019) • **FULL REVIEW** Feb 2020

### SAMSUNG Galaxy Tab S6 Lite

★★★★★

£349 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
RECOMMENDED

This is a fairly stark downgrade from the standard Tab S6, at least in performance terms, but it's nonetheless a very accomplished mid-range Android tablet. You get an S Pen stylus included in the box, too, for even more value.



**PROCESSOR** Octa-core 2.3GHz Samsung Exynos 9611 • **SCREEN SIZE** 10.4in • **SCREEN RESOLUTION** 2,000x1,200 • **REAR CAMERA** 8 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G (cellular model only) • **DIMENSIONS** 245x154x7mm • **WEIGHT** 465g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** [www.samsung.com](http://www.samsung.com) • **PART CODE** SM-P610NZAABTU • **FULL REVIEW** Sep 2020

### MICROSOFT Surface Go 2

★★★★★

£509 • [www.microsoft.com](http://www.microsoft.com)

**COMPUTER SHOPPER**  
RECOMMENDED

Yes, the Surface Go 2 is only half the device it can be without its sold-separately keyboard, but put together they make for a magnificently portable 2-in-1 that captures almost everything good about the Surface family as a whole.



**PROCESSOR** Dual-core 1.1GHz Intel Core m3-8100Y • **SCREEN SIZE** 10.5in • **SCREEN RESOLUTION** 1,920x1,280 • **REAR CAMERA** 8 megapixels • **STORAGE** 128GB • **WIRELESS DATA** No • **DIMENSIONS** 245x175x8.3mm • **WEIGHT** 745g (with keyboard) • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** [www.microsoft.com](http://www.microsoft.com) • **PART CODE** SUA-00002 • **FULL REVIEW** Sep 2020

### SAMSUNG Galaxy Tab S6

★★★★★

£601 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
RECOMMENDED

The Tab S6 is no simple slate. Samsung's DeX interface turns it into a viable 2-in-1 laptop alternative, something that's further enabled by its powerful processor and glorious, high-resolution touchscreen.



**PROCESSOR** Quad-core 2.84GHz Qualcomm Snapdragon 855 • **SCREEN SIZE** 10.5in • **SCREEN RESOLUTION** 2,560x1,440 • **REAR CAMERAS** 15 megapixels, 3 megapixels • **STORAGE** 128GB • **WIRELESS DATA** No • **DIMENSIONS** 245x160x5.7mm • **WEIGHT** 420g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk) • **PART CODE** SM-T860NZAABTU • **FULL REVIEW** Apr 2020

### APPLE iPad Pro 12.9in (2020)

★★★★★

£1,619 • [www.apple.com/uk](http://www.apple.com/uk)

**COMPUTER SHOPPER**  
RECOMMENDED

Another powerful iPad Pro, now with a slick 120Hz display and iPadOS tweaks that make it even better as a laptop alternative. The keyboard attachment's trackpad is a welcome addition as well, though you'll need to buy this separately.



**PROCESSOR** Octa-core 2.4GHz Apple A12X Bionic • **SCREEN SIZE** 12.9in • **SCREEN RESOLUTION** 2,732x2,048 • **REAR CAMERAS** 12 megapixels, 10 megapixels • **STORAGE** 1TB • **WIRELESS DATA** Wi-Fi • **DIMENSIONS** 281x215x5.9mm • **WEIGHT** 643g • **OPERATING SYSTEM** iPadOS • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** iPad Pro 12.9in (2020) • **FULL REVIEW** Oct 2020



# Choosing a... TV

**01** A 32in Full HD TV costs around £200, but premium larger 4K models can be closer to £2,000. TVs look much smaller in the shop than in your home, so measure the space available before you buy.

Curved TVs are becoming increasingly more common, but bear in mind that these typically take up more floor space than a traditional flat set.

**02** A 1,920x1,080-resolution TV can display a 1080p image. You can still buy TVs with a 720p (1,366x768) resolution, but they're no cheaper and the image won't be as sharp. 3,840x2,560 Ultra HD resolution, or 4K, TVs are finally available at reasonable prices, although you'll still pay a premium for one over a 1080p model.

**03** Consider the number of inputs you'll need to connect the rest of your equipment. Two HDMI ports should be the bare minimum, but many TV sets come with four HDMI connectors. You'll need HDMI 2.0 if you want a future-proof 4K TV, as this is the only way to get 60fps video playback from external sources at such a high resolution.

If you want to plug a PC into your TV, you'll need to use either HDMI or VGA inputs. Be aware that some TVs only let you use a PC on an analogue input, and others won't display the Windows desktop at the TV's highest resolution.

**04** The contrast ratio tells you the difference between the darkest

and the brightest shades that the screen will be able to display. The higher the number, the darker the blacks and the brighter the whites. Buy a TV with High Dynamic Range (HDR) support for the best picture from supported services.

**05** HD content is now becoming fairly widespread, but if you want Ultra HD content your options are more limited. Most Ultra HD TVs have Netflix built into their smart TV systems, but only BT is currently providing live Ultra HD video, with BT Sport Ultra HD.

Ultra HD Blu-ray players give you an amazing picture, and Amazon's Fire TV set-top box will stream its Prime Video service and Netflix at Ultra HD resolutions.

## HOME CINEMA

### HISENSE

R50B7120UK

★★★★★

£349 • [www.argos.co.uk](http://www.argos.co.uk)



This VA-based smart TV isn't just cheap for a 4K model; it's a collaboration with Roku, which means it has the most well-serviced smart streaming platform built right in.

SCREEN SIZE 55in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 3x HDMI • TUNER Freeview HD • DIMENSIONS 1,127x720x256mm • WARRANTY Two years RTB • DETAILS [www.hisense.co.uk](http://www.hisense.co.uk) • PART CODE R50B7120UK • FULL REVIEW Jul 2020

### LG OLED55CX6LA

★★★★★

£1,599 • [www.currys.co.uk](http://www.currys.co.uk)



NEW ENTRY



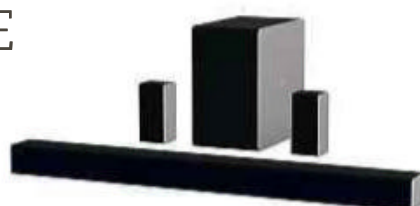
An excellent all-rounder of an OLED TV. With its high colour accuracy and low response time, film fanatics and gaming aficionados alike will find something to love with the OLED55CX6LA.

SCREEN SIZE 55in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 4x HDMI • TUNER N/A • DIMENSIONS 1,228x738x251mm • WARRANTY One year parts and labour • DETAILS [www.lg.com](http://www.lg.com) • PART CODE OLED55CX6LA • FULL REVIEW Nov 2020

### VIZIO SB36512-F6E

★★★★★

£593 • [www.amzn.to/2ALZjxi](http://www.amzn.to/2ALZjxi)



A full 5.1.2 surround-sound system at this price sounds unlikely, but the SB36512-F6E isn't just a cheap soundbar/subwoofer/speaker package: it's a genuinely great-sounding one, and with loads of side features, too.

SPEAKERS 5+1+1 • RMS POWER OUTPUT Not stated • DIMENSIONS 914x81x64mm (soundbar), 290x177x290mm (subwoofer), 145x68x65mm (speakers) • WEIGHT 2.5kg (soundbar), 4.6kg (subwoofer), 397g (speakers) • DOCK CONNECTOR None • NETWORKING 802.11ac Wi-Fi, Ethernet • WARRANTY One year RTB • DETAILS [www.viziosoundbar.uk](http://www.viziosoundbar.uk) • PART CODE SB36512-F6E • FULL REVIEW Aug 2020

### POLK AUDIO Command Bar

★★★★★

£349 • [www.amzn.to/33TdAv4](http://www.amzn.to/33TdAv4)



This is a genius combination of soundbar and smart speaker, and for a low price too. It's great for films, TV and music, and you can use Alexa as a voice-activated remote control.

SPEAKERS 3 • RMS POWER OUTPUT 260W • DIMENSIONS 1,091x102x51mm (soundbar), 367x188x368mm (subwoofer) • WEIGHT 2.3kg (soundbar), 3.9kg (subwoofer) • DOCK CONNECTOR None • NETWORKING 802.11ac Wi-Fi • WARRANTY Three years RTB • DETAILS [en.polkaudio.com](http://en.polkaudio.com) • PART CODE COMMANDUK • FULL REVIEW Oct 2019

### PANASONIC TX-40GX800B

★★★★★

£503 • [www.panasonic.com](http://www.panasonic.com)



This is a good match for anyone who can live without OLED or QLED tech, but wants a good mix of features and connectivity. It's a fairly basic VA panel, but this is enough for high picture quality, with support for HDR10+ and Dolby Vision.

SCREEN SIZE 40in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 3x HDMI, Composite • TUNER Freeview Play • DIMENSIONS 901x573x236mm • WARRANTY Five years RTB • DETAILS [www.panasonic.com](http://www.panasonic.com) • PART CODE TX-40GX800B • FULL REVIEW Sep 2020

### SONOS Beam

★★★★★

£368 • [www.amzn.to/2RJpMef](http://www.amzn.to/2RJpMef)



The Beam could join a home cinema setup on sound quality alone, but it's loaded with smart features, too. It can adjust sound output to the size and layout of a room, for example, and form a multiroom system with other Sonos speakers.

SPEAKERS 5 • RMS POWER OUTPUT Not stated • DIMENSIONS 651x100x69mm • WEIGHT 2.8kg • DOCK CONNECTOR None • NETWORKING 802.11ac Wi-Fi, Ethernet • WARRANTY One year RTB • DETAILS [www.sonos.com](http://www.sonos.com) • PART CODE BEAM1UK1 • FULL REVIEW Apr 2019



# Choosing a... Bluetooth speaker

**01** Bluetooth speakers come in all shapes and sizes, so you'll need to decide what you want to do with the speaker before you buy. If you don't plan to take your music outdoors or around the house, look for a wired speaker. These are typically cheaper than speakers with built-in batteries.

If you do want a portable speaker, however, pay particular attention to how much it weighs. Ruggedised models should be able to survive accidental drops, water spills and unexpected rain showers.

**02** Many of the cheapest Bluetooth speakers use the lossy A2DP Bluetooth protocol, which is prone to compressing your music and discarding detail compared with the original recording.

It's hard to tell the difference when listening to pocket-sized speakers, but if you're looking for a speaker to fill a room, an aptX-compatible device is a better option. This Bluetooth protocol retains more detail than the A2DP profile, although you'll need to use it with a compatible smartphone in order to get the benefits.

**03** As with any audio product, the number and size of speaker drivers can have a significant impact on the quality of sound you get from a Bluetooth speaker. Typically, the presence of multiple drivers enables the manufacturer to tune each one for specific frequencies, directing high-end sounds towards a tweeter and sending the mid-range frequencies to the main driver.

Single-driver speakers with larger driver cones can be just as capable of producing fantastic audio, however.

**04** Most Bluetooth speakers have at least one auxiliary input for a wired 3.5mm audio jack, in case you want to listen to music from a device that doesn't have Bluetooth.

There are other extra features to look out for, though. Speakers with built-in batteries may have a USB port for charging your smartphone, or a built-in microphone to turn it into a speakerphone when a paired smartphone receives a call. Not all speakers have physical controls; many rely on your paired device's controls for adjusting the volume or muting playback.

## AUDIO

### CREATIVE Outlier Air

★★★★★

£55 • [uk.creative.com](http://uk.creative.com)

**COMPUTER SHOPPER**  
BEST BUY

A marvellous set of true wireless



headphones, the Outlier Air combine a lively and dynamic sound with a comfy (if large) design and long battery life. Bluetooth aptX support is worth the money in particular.

HEADPHONES SUBTYPE In-ear headset • PLUG TYPE None • WEIGHT 10g • CABLE LENGTH N/A • WARRANTY Two years RTB • DETAILS [uk.creative.com](http://uk.creative.com) • PART CODE Outlier Air • FULL REVIEW Jul 2019

### SONY WH-1000XM3

★★★★★

£248 • [www.amzn.to/2HHUG1J](http://www.amzn.to/2HHUG1J)

**COMPUTER SHOPPER**  
BEST BUY

Bose's QuietComfort headphones have at last been toppled from the ANC



throne. The WH-1000XM3 headphones don't just sound outstanding, with very effective noise cancellation, but they're smartly designed and come with a host of extras.

HEADPHONES SUBTYPE Over-ear headset • PLUG TYPE 3.5mm jack plug (optional) • WEIGHT 255g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS [www.sony.co.uk](http://www.sony.co.uk) • PART CODE WH-1000XM3 • FULL REVIEW May 2019

### IKEA Symfonisk

★★★★★

£89 • [www.ikea.com](http://www.ikea.com)

**COMPUTER SHOPPER**  
BEST BUY

Ikea, with a little help from Sonos, has produced two great-sounding wired speakers. The cheaper 'bookshelf' model is slim and subtle, but it's worth paying extra for the 'lamp' model, which both sounds fuller and doubles as a working lamp.



SPEAKERS 2 • RMS POWER OUTPUT Not stated • WEIGHT Not stated • NETWORKING Wi-Fi • WARRANTY One year RTB • DETAILS [www.ikea.com](http://www.ikea.com) • PART CODE Symfonisk • FULL REVIEW Nov 2019

### SONOS Move

★★★★★

£399 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

Although this is much bigger and less portable than most Bluetooth speakers, it's worth taking with you when you can. It sounds absolutely superb, and supports Trueplay, so can automatically adjust its output to fit the acoustics of its surroundings.



SPEAKERS 2 • RMS POWER OUTPUT Not stated • DOCK CONNECTOR None • NETWORKING 802.11n Wi-Fi, Bluetooth • DIMENSIONS 240x160x126mm • WEIGHT 3kg • WARRANTY One year RTB • DETAILS [www.sonos.com](http://www.sonos.com) • PART CODE MOVE1UK1BLK • FULL REVIEW Jan 2020

### NAIM Mu-so Qb 2nd Generation

★★★★★

£749 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
BEST BUY

For a Bluetooth speaker this is immensely expensive, especially as it's mains-powered and thus not fully wireless. Nevertheless, its sound output is as expansive as it is customisable, and it can automatically adjust to its physical surroundings for the best tone.



SPEAKERS 5 • RMS POWER OUTPUT 300W • DOCK CONNECTOR None • NETWORKING 802.11ac Wi-Fi, Bluetooth • DIMENSIONS 1210x218x212mm • WEIGHT 5.6g • WARRANTY Two years RTB • DETAILS [www.naimaudio.com](http://www.naimaudio.com) • PART CODE MUSO2QB • FULL REVIEW Jun 2020

### CREATIVE T100

★★★★☆

£100 • [uk.creative.com](http://uk.creative.com)

**COMPUTER SHOPPER**  
RECOMMENDED

These are no standard stereo desktop speakers. You can connect additional devices via 3.5mm or Bluetooth, or control them at range with the included remote. However you use the T100, they'll always sound rich and detailed, with plenty of bass for a 2.0 system.



SPEAKERS 1 • RMS POWER OUTPUT 80W • WEIGHT 2kg • NETWORKING Bluetooth • WARRANTY Two years RTB • DETAILS [uk.creative.com](http://uk.creative.com) • PART CODE T100 • FULL REVIEW Jul 2020



# Choosing a... Media streamer

**01** Media streamers have come a long way from the hard disk-based set-top boxes of a few years ago. They now come in two main forms: flash drive-sized dongles that plug directly into the HDMI port in the back of your TV, and larger microconsoles that sit under it. Whichever model you choose, it will stream content from the internet rather than storing media files locally.

**02** Most streamers use their own operating system, which you can navigate with a bundled remote control, but Google's Chromecast dongle requires a paired smartphone, tablet or laptop to stream content on the big screen. If you're looking to set up Netflix for

someone who doesn't have a smartphone, buy a standalone streamer such as a Roku or Amazon Fire TV device.

**03** A media streamer is only as good as the services it supports, although a device that offers more services won't necessarily offer more high-quality content than a media streamer with fewer channels. Instead, look out for major channels such as Netflix, Amazon Instant Video, BBC iPlayer, Sky Go and YouTube. If any of these are missing, the remaining channels aren't likely to be much cop.

**04** Although nearly all streamers now pull content from the web, they're still capable of playing content stored locally

from a networked PC or NAS device. Not all streamers are capable of playing all media file formats, however. If you have a lot of MKV or MOV files, check that your chosen streamer supports them before you buy. These are typically the file formats devices struggle with the most.

**05** Media streamers aren't just for video, either. Many support online music services including Spotify, Rdio and TuneIn Radio. Others essentially use the same hardware as a smartphone and are capable of running apps or playing games. Some of the most powerful are compatible with dedicated game controllers, but these are typically sold as optional accessories rather than bundled with the streamer.

## VIDEO

### AMAZON Fire TV Stick 4K

★★★★★

£50 • [www.amzn.to/2Y6q8wh](http://www.amzn.to/2Y6q8wh)

**COMPUTER SHOPPER**  
RECOMMENDED

From set-top box to dangling dongle and now an ultra-compact stick, Amazon's 4K media streamer gets sleeker with every generation. It's also been updated with a new remote, which includes a microphone for Alexa voice commands.



**VIDEO OUTPUTS** HDMI 2.0 • **NETWORKING** 802.11ac Wi-Fi • **DIMENSIONS** 108x30x14mm • **STREAMING FORMATS** UPnP, AirPlay, DLNA, Plex • **INTERNET STREAMING SERVICES** Amazon Video, Netflix, BBC iPlayer, ITV Hub, All 4, My5 • **WARRANTY** One year RTB • **DETAILS** [www.amazon.co.uk](http://www.amazon.co.uk) • **PART CODE** Fire TV Stick 4K • **FULL REVIEW** May 2019

### DJI Osmo Pocket

★★★★★

£329 • [store.dji.com](http://store.dji.com)

**COMPUTER SHOPPER**  
RECOMMENDED

A cleverly made alternative to action cameras, the DJI Osmo Pocket isn't intended for extreme sports, but its mechanical stabilisation ensures smooth, great-looking footage for life-logging videos.



**SENSOR** 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels • **MAXIMUM RECORDING RESOLUTION** 4K (60fps) • **AV CONNECTIONS** USB Type-C • **DIMENSIONS** 122x37x38mm • **WEIGHT** 116g • **WARRANTY** One year RTB • **DETAILS** [www.dji.com](http://www.dji.com) • **PART CODE** CP.ZM.00000097.01 • **FULL REVIEW** Apr 2019

### ROKU Streaming Stick+ (2nd Gen)

★★★★★

£50 • [www.roku.com](http://www.roku.com)

**COMPUTER SHOPPER**  
BEST BUY

No other media streamer offers the same vast range of integrated services as the Streaming Stick+, and all that content is presented in a wonderfully user-friendly interface with universal voice support.



**VIDEO OUTPUTS** HDMI 2.0 • **NETWORKING** 802.11ac Wi-Fi • **DIMENSIONS** 94x20x12mm • **STREAMING FORMATS** DLNA, Plex • **INTERNET STREAMING SERVICES** BBC iPlayer, Netflix, Google Play Movies & TV, Amazon Video, YouTube, ITV Hub, All4, My5, Now TV, Apple TV • **WARRANTY** One year RTB • **DETAILS** [www.roku.com](http://www.roku.com) • **PART CODE** 3810EU • **FULL REVIEW** Aug 2020

### GOPRO Hero 8 Black

★★★★★

£279 • [gopro.com](http://gopro.com)

**COMPUTER SHOPPER**  
BEST BUY

Instead of completely rewriting the Hero 7 Black's formula, the Hero 8 Black focuses more on smaller improvements, such as to its stabilisation and timelapse features. To GoPro's credit, this approach works: this is a truly brilliant action camera.



**SENSOR** 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels • **MAXIMUM RECORDING RESOLUTION** 4K (60fps) • **AV CONNECTIONS** None • **DIMENSIONS** 49x66x28mm • **WEIGHT** 126g • **WARRANTY** One year RTB • **DETAILS** [www.gopro.com](http://www.gopro.com) • **PART CODE** CHDHX-801-RW • **FULL REVIEW** Mar 2020

### APPLE TV 4K

★★★★★

£179 • [www.apple.com/uk](http://www.apple.com/uk)

**COMPUTER SHOPPER**  
RECOMMENDED

This big update adds 4K content (including, for the first time, Amazon Video support). The best part is that if there's a 4K version of content you've previously purchased in HD, Apple will upgrade it free of charge.



**VIDEO OUTPUTS** HDMI 2.0a • **NETWORKING** 802.11ac Wi-Fi, 10/100/1,000 Ethernet • **DIMENSIONS** 35x98x98mm • **STREAMING FORMATS** AirPlay, others via apps • **INTERNET STREAMING SERVICES** iTunes, Apple Music, Netflix, Amazon Instant Video, Now TV, BBC iPlayer, ITV Hub, All 4 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** Apple TV 4K • **FULL REVIEW** Jan 2018

### GOPRO Max

★★★★★

£457 • [www.amzn.to/2xbbAmb](http://www.amzn.to/2xbbAmb)

**COMPUTER SHOPPER**  
BEST BUY

At last, a 360° camera that is all things to all users. The GoPro Max manages to be both usable for beginners and sufficiently advanced for more experienced videographers, shooting super-smooth footage with plenty of extra features to try.



**SENSOR** 2x 1/2.3in CMOS • **SENSOR PIXELS** 2x 16 megapixels • **MAXIMUM RECORDING RESOLUTION** 5.6K (30fps) • **AV CONNECTIONS** None • **DIMENSIONS** 64x69x40mm • **WEIGHT** 163g • **WARRANTY** One year RTB • **DETAILS** [www.gopro.com](http://www.gopro.com) • **PART CODE** CHDHZ-201-RW • **FULL REVIEW** Feb 2020



# Choosing a... Compact system camera

**01** If you're ready to step beyond the basic controls of a compact camera, or you want greater flexibility than an ultra-zoom can offer, a compact system camera (CSC) is the next logical upgrade. With interchangeable lenses, manual controls and stellar image quality, these cameras give proper digital SLRs a run for their money.

**02** There are three competing types of CSC mount, and the one you buy determines the number of compatible lenses and accessories you have available. Samsung's NX-mount is arguably the most limited in terms of lens selection, and the company has confirmed that it's shutting down its European camera business, so it's best to avoid these altogether if possible.

Sony's E-Mount has a slightly wider range, but Micro Four Thirds offers the widest variety. Both Panasonic and Olympus cameras use this mount, and the lenses are interchangeable between manufacturers.

**03** Micro Four Thirds cameras are typically more compact than other types of CSC because the image sensor is physically smaller – with a 22mm diagonal, it's roughly 30% smaller than an APS-C sensor. The APS-C sensors that Sony and Samsung use in their CSCs are the same size as those in traditional digital SLRs.

**04** Like digital SLRs, CSCs come at a wide range of prices. Available from as little as £200, there's a CSC to suit every

budget. Most come with at least one kit lens, but if you already have lenses for a particular CSC mount, you can buy the body on its own and save money.

**05** Once you've settled on a particular mount, you should pay attention to a camera's features. Articulating screens and integrated viewfinders will help you compose shots, while extra physical controls and a hotshoe mount will give you flexibility for manual shooting.

Touchscreens are great, but they're no replacement for physical dials when it comes to changing shutter speed and aperture. An integrated flash is much more convenient than a detachable one, as you can never forget to take it with you.

## PHOTOGRAPHY

### CANON EOS R

★★★★★

£2,049 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
RECOMMENDED

This is Canon's first mirrorless full-frame camera, but you wouldn't know it. Image quality is among the very best, and the included kit lens does a fantastic job. You can also get it body-only and attach your own RF-mount lenses.



SENSOR RESOLUTION 30.3 megapixels • SENSOR SIZE 36x24mm • FOCAL LENGTH MULTIPLIER 1x • VIEWFINDER Electronic (3.6 million dots) • LCD SCREEN 3.2in (2,100,000 dots) • VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE) 0.76x, 100% • WEIGHT 580g • DIMENSIONS 98x136x84mm • WARRANTY One year RTB • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • FULL REVIEW Sep 2019

### CANON EOS 250D

★★★★★

£579 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
RECOMMENDED

This is an ideal camera for first-time DSLR buyers. Excellent user-friendliness combines with high image quality for a very good-value shooter. Videos also look great, but there's definitely more of a focus on stills.



SENSOR RESOLUTION 24.1 megapixels • SENSOR SIZE 23.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.6x • VIEWFINDER Optical • LCD SCREEN 3in (1.04 million dots) • VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE) 0.87x, 95% • WEIGHT 449g • DIMENSIONS 93x122x70mm • WARRANTY One year RTB • DETAILS [www.canon.co.uk](http://www.canon.co.uk) • FULL REVIEW Jun 2020

### NIKON Z6

★★★★★

£1,649 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
RECOMMENDED

If you can't quite afford the exemplary Z7, then the Z6 is the perfect alternative. It's every bit the mirrorless all-rounder, and while it has a lower-resolution sensor than the Z7, this allows it to shoot at a faster rate.



SENSOR RESOLUTION 24.5 megapixels • SENSOR SIZE 35.9x23.9mm CMOS • VIEWFINDER Electronic (3.69 million dots) • LCD SCREEN 3.2in (2 million dots) • VIEWFINDER MAGNIFICATION (35MM-EQUIVALENT, COVERAGE) 0.8x, 100% • WEIGHT 1,175g • SIZE (HXWXD) 101x134x68mm • WARRANTY One year RTB • DETAILS [www.europe-nikon.com](http://www.europe-nikon.com) • FULL REVIEW Jul 2019

### POLAROID Originals OneStep 2

★★★★★

£75 • [www.amzn.to/2DQhr05](http://www.amzn.to/2DQhr05)

**COMPUTER SHOPPER**  
RECOMMENDED

The OneStep 2 brings back the simple joys of instant photography. Although the stock can get quite pricey, your shots will look just as they would on a classic Polaroid – perfect for sharing or simply sticking to the fridge.



PHOTO SIZE 3.1x3.1in • BATTERY LIFE 15-20 packets of film • PORTS 1x Micro USB • WARRANTY One year RTB • DETAILS [www.polaroidoriginals.com](http://www.polaroidoriginals.com) • FULL REVIEW Jan 2018

### NIKON D780

★★★★★

£2,199 • [www.parkcameras.com](http://www.parkcameras.com)

**COMPUTER SHOPPER**  
BEST BUY

Possibly the best top-tier DSLR we've ever tested, the D780 shines with outrageously good picture quality, easy usability and brilliant ISO performance. Battery life is a highlight, too, with 2,260 shots available from a single charge.



SENSOR RESOLUTION 24.5 megapixels • SENSOR SIZE 35.9x23.9mm (CMOS) • FOCAL LENGTH MULTIPLIER 1x • VIEWFINDER Optical • LCD SCREEN 3.2in (2.36 million dots) • LENS MOUNT Nikon F-mount • WEIGHT 840g • DIMENSIONS 116x144x76mm • WARRANTY One year RTB • DETAILS [www.nikon.co.uk](http://www.nikon.co.uk) • FULL REVIEW Jul 2020

### SONY RX100 VII

★★★★★

£1,199 • [www.wexphotovideo.com](http://www.wexphotovideo.com)

**COMPUTER SHOPPER**  
RECOMMENDED

We've never used a compact system camera that shoots as well as the RX100 VII. Stills look superb, and video support is even better, with smooth footage and fast, silent autofocus.



SENSOR RESOLUTION 20.1 megapixels • SENSOR SIZE 13.2x9.8mm • FOCAL LENGTH MULTIPLIER 2.7x • VIEWFINDER Electronic (2.4 million dots) • LCD SCREEN 3in (921,000 dots) • WEIGHT 302g • DIMENSIONS 58x102x43mm • WARRANTY One year RTB • DETAILS [www.sony.com](http://www.sony.com) • FULL REVIEW Apr 2020



# Choosing a... Wearable

**01** Wearable tech can include anything from chest-strap heart-rate monitors to augmented reality glasses, but the two most common types are smartwatches and fitness trackers. Both are designed to sit unassumingly on your wrist, and are almost always meant to be used in tandem with a paired smartphone.

**02** Smartwatches are typically more complex and expensive, though more closely resemble a traditional wristwatch. You can use them to receive and reply to text messages and emails, quickly check maps and even play games – like a smartphone, most smartwatches allow you to install your own choice of apps.

**03** Fitness trackers are much more dedicated to healthy pursuits. Step counters, heart-rate monitors and even sleep tracking are all common, and the data collected is fed back to you so you can see how your workout routine or calorie intake is going.

Many smartwatches also contain health-tracking features, but fitness-specific wearables tend to be cheaper, smaller and lighter.

**04** When it comes to battery life, it's important for any wearable to last a full day, but if it's a smartwatch then you can get away with having to charge it overnight. With fitness trackers, it's better if it lasts for several days off

a single charge, so you can wear it to bed and benefit from sleep tracking.

**05** Look out for waterproofing as well. Wearables that don't mind a few lengths of the pool can be used for swimming or just timekeeping, and at the very least we expect a fitness tracker to be able to deal with rain or sweat.

**06** Different smartwatches use different operating systems, which determine which apps you can install on your device, as well as compatibility with smartphones. Android Wear and Tizen smartwatches will work with both Android and iOS phones, but Apple's watchOS will only pair with an iOS handset.

## WEARABLES

### HONOR Band 5

★★★★★

£27 • [www.amzn.to/36nRxNz](http://www.amzn.to/36nRxNz)

**COMPUTER SHOPPER**  
RECOMMENDED

This is a perfect fitness band if you're just starting out on an exercise routine. It's light, long-lasting between charges and accurate at measurements, a combination you won't often see on something so cheap.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 0.95in • RESOLUTION 240x120 • OS SUPPORT Android, iOS • BATTERY LIFE Two weeks • WARRANTY One year RTB • DETAILS [www.hihonor.com](http://www.hihonor.com) • PART CODE KYG3649645453002TV • FULL REVIEW Feb 2020

### APPLE Watch Series 5

★★★★★

£399 • [www.apple.com/uk](http://www.apple.com/uk)

**COMPUTER SHOPPER**  
BEST BUY

The latest Apple Watch is, once again, not a major overhaul, but the always-on display is a nice little upgrade. The new compass also helps with navigation, and the Health app redesign helps display fitness stats more clearly.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.78in • RESOLUTION 448x368 • OS SUPPORT iOS • BATTERY LIFE 18 hours • WARRANTY One year RTB • DETAILS [www.apple.com/uk](http://www.apple.com/uk) • PART CODE Apple Watch Series 5 • FULL REVIEW Jan 2020

### GARMIN Vivoactive 4

★★★★★

£259 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

One of the best fitness watch series gets another great instalment. The Vivoactive 4 is well designed, tracks an eclectic mix of activities and introduces some unique new features, including animated guides to workouts.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.3in • RESOLUTION 260x260 • OS SUPPORT Android, iOS • BATTERY LIFE Five days • WARRANTY One year RTB • DETAILS [www.garmin.com](http://www.garmin.com) • PART CODE 010-02174-02 • FULL REVIEW Mar 2020

### FITBIT Inspire HR

★★★★★

£75 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
BEST BUY

There's no better sub-£100 fitness tracker for casual users than this. The Inspire HR's simplicity and stylishness give it immediate appeal, and you'll stay for the top-quality mobile app.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 0.7in • RESOLUTION 128x72 • OS SUPPORT Android, iOS • BATTERY LIFE Five days • WARRANTY One year RTB • DETAILS [www.fitbit.com](http://www.fitbit.com) • PART CODE FB505RGPK-EU • FULL REVIEW Jul 2019

### GARMIN Fenix 5 Plus

★★★★★

£379 • [www.runningxpert.com](http://www.runningxpert.com)

**COMPUTER SHOPPER**  
BEST BUY

You'll have to pay a pretty penny for it, but the variety of features on the Fenix 5 Plus is without peer. One of the most exclusive is its support for full-colour maps, along with the ability to create routes straight from your wrist.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.2in • RESOLUTION 240x240 • OS SUPPORT Android, iOS • BATTERY LIFE 18 hours • WARRANTY One year RTB • DETAILS [www.garmin.com](http://www.garmin.com) • PART CODE 010-01988-11 • FULL REVIEW Nov 2019

### MOBVOI TicWatch E2

★★★★☆

£146 • [www.mobvoi.com](http://www.mobvoi.com)

**COMPUTER SHOPPER**  
RECOMMENDED

At this price, there's simply no better smartwatch/fitness tracker hybrid than the TicWatch E2. Built-in GPS, IP67 waterproofing and an upgraded battery are all on board, and it's more responsive than most Wear 2100 wearables.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.4in • RESOLUTION 400x400 • OS SUPPORT Android, iOS • BATTERY LIFE Two days • WARRANTY One year RTB • DETAILS [www.mobvoi.com](http://www.mobvoi.com) • PART CODE TicWatch E2 • FULL REVIEW Jun 2019



## SOFTWARE

### ADOBE Premiere Pro CC 2019

★★★★★

£20 per month • [www.adobe.com](http://www.adobe.com)



This strong update of Premiere Pro CC adds improved Lumetri Color controls and neat integration with the Premiere Rush mobile app, among other tweaks.

**OS SUPPORT** Windows 10 version 1703 and later, macOS 10.12 and later (10.13 required for hardware acceleration) • **MINIMUM CPU** Intel 6th-gen and later, AMD equivalents • **MINIMUM GPU** Integrated graphics • **MINIMUM RAM** 8GB • **HARD DISK SPACE** 8GB • **DETAILS** [www.adobe.com](http://www.adobe.com) • **PRODUCT CODE** Premiere Pro CC • **FULL REVIEW** Jul 2019

Video-editing software

### KASPERSKY Internet Security

★★★★★

£25 • [www.amzn.to/3aOISqj](http://www.amzn.to/3aOISqj)



Not only is this one of the most fortified security suites on the market, it's also one of the best designed, and there are loads of extra features.

**OS SUPPORT** Windows 7/8.1/10, macOS 10.12 or later, Android, iOS • **MINIMUM CPU** 1GHz • **MINIMUM GPU** None • **MINIMUM RAM** 1GB (32-bit), 2GB (64-bit) • **HARD DISK SPACE** 1.5GB • **DETAILS** [www.kaspersky.co.uk](http://www.kaspersky.co.uk) • **PRODUCT CODE** Internet Security • **FULL REVIEW** Mar 2020

Security software

### NORDVPN (2020)

★★★★★

£3 per month • [www.nordvpn.com](http://www.nordvpn.com)



NordVPN has spent two years making its VPN more secure than ever, and with high performance and supreme ease of use, there's really nothing bad to say about its current iteration.

**OS SUPPORT** Windows, macOS, Linux iOS, Android • **DETAILS** [www.nordvpn.com](http://www.nordvpn.com) • **PRODUCT CODE** NordVPN • **FULL REVIEW** Sep 2020

Virtual private network

### CYBERGHOST VPN

★★★★★

£2.10 per month • [www.cyberghostvpn.com](http://www.cyberghostvpn.com)



In addition to safeguarding your privacy, CyberGhost VPN is particularly well suited to unblocking content on different streaming services. Connecting to new servers could be a bit faster, but once you're connected, everything is nice and stable.

**OS SUPPORT** Windows, macOS, iOS, Android • **DETAILS** [www.cyberghostvpn.com](http://www.cyberghostvpn.com) • **PRODUCT CODE** CyberGhost VPN • **FULL REVIEW** Nov 2019

Virtual private network

### McAfee Internet Security 2019

★★★★★

£15 • [www.amzn.to/2X5sQBL](http://www.amzn.to/2X5sQBL)



Impressively, the 2019 version takes McAfee Internet Security from an industry damp squib to one of the most reliable security suites on the market. Malware detection is vastly improved and performance is better, too.

**OS SUPPORT** Windows 7/8/8.1/10, macOS 10.12 and later; Android 4.1 and later, iOS 10 and later • **MINIMUM CPU** 1GHz • **MINIMUM GPU** DirectX 9 • **MINIMUM RAM** 1GB • **HARD DISK SPACE** 500MB • **DETAILS** [www.mcafee.com](http://www.mcafee.com) • **FULL REVIEW** Apr 2019

Security software

### APPLE macOS 10.14 Mojave

★★★★★

Free • [itunes.apple.com](http://itunes.apple.com)



Mojave's small UI improvements and minor added features would disappoint on their own, but together they add up to a great update. It's free, too, so there's no reason not to make the switch.

**OS SUPPORT** OS X Mountain Lion or later • **MINIMUM CPU** Not stated • **MINIMUM GPU** Integrated graphics • **MINIMUM RAM** 2GB • **HARD DISK SPACE** 12.5GB • **DETAILS** [www.apple.com](http://www.apple.com) • **FULL REVIEW** Jan 2019

OS update

## GAMING

### NINTENDO Switch Lite

★★★★★

£200 • [www.argos.co.uk](http://www.argos.co.uk)



The Switch Lite can't be used with a TV like the standard Switch, nor can you detach its controllers, but with a lower price, more compact design and all the same power, it's still a great handheld console.

**PROCESSOR** Octa-core 1.9GHz Nvidia Tegra X1 • **RAM** 4GB LPDDR4 • **FRONT USB PORTS** None • **REAR USB PORTS** 1x USB Type-C • **STORAGE** 32GB • **WARRANTY** One year RTB • **DETAILS** [www.nintendo.com](http://www.nintendo.com) • **PART CODE** Nintendo Switch Lite • **FULL REVIEW** Jan 2020



Handheld games console

### OCULUS Go

★★★★★

£189 • [www.johnlewis.com](http://www.johnlewis.com)



No longer do you need a decked-out PC or premium smartphone to enjoy VR. The Oculus Go crams all the hardware you need into the headset itself, making virtual reality entertainment as immediate and accessible as it's ever been.

**DISPLAY** LCD • **RESOLUTION** 2,560x1,440 • **REFRESH RATE** 72Hz • **PROCESSOR** Octa-core 2.4GHz Qualcomm Snapdragon 821 • **RAM** 3GB • **WEIGHT** 467g • **DETAILS** [www.oculus.com/go](http://www.oculus.com/go) • **PART CODE** Go 32GB • **FULL REVIEW** Sep 2018



VR headset

### NINTENDO Labo VR Kit

★★★★★

£70 • [www.studio.co.uk](http://www.studio.co.uk)



This addition to the cardboard-based Labo series turns your Nintendo Switch into a platform for a myriad of inventive VR minigames. Kids in particular will enjoy constructing the goggles and controllers themselves.

**AVAILABLE FORMATS** Nintendo Switch • **DISK SPACE** Not stated • **DETAILS** [labo.nintendo.com](http://labo.nintendo.com) • **PART CODE** Nintendo Labo VR Kit • **FULL REVIEW** Aug 2019



VR headset and games

### NVIDIA GeForce Now

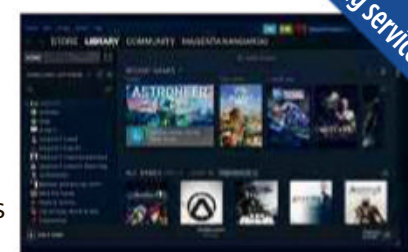
★★★★★

£5 per month • [www.nvidia.com](http://www.nvidia.com)



Google Stadia gets more headlines but GeForce Now, with its ability to dip into your existing library of PC games, is the best game-streaming service right now.

**SYSTEM REQUIREMENTS** Windows 7, 8.1, 10; Android 5.0, macOS 10.10; Nvidia Shield TV; 4GB RAM (Windows); 2GB RAM (Android) • **DETAILS** [www.nvidia.com](http://www.nvidia.com) • **PART CODE** GeForce Now • **FULL REVIEW** June 2020



Game-streaming service



# Free software guide

It's easy to access your free software. Just go to [www.shopperdownload.co.uk/394](http://www.shopperdownload.co.uk/394) and register with the code printed on the spine of the magazine cover

## DOWNLOADING YOUR SOFTWARE

Enter [www.shopperdownload.co.uk/394](http://www.shopperdownload.co.uk/394) into your browser's address bar. In the New user section, enter your email address and the coupon code printed on the spine of the magazine cover, then click the Register button. Browse through this month's choices and follow the online instructions to download and register the software.

You may need to register a user account for our software store and enter your coupon code more than once.

The registration process varies from program to program, so read the instructions carefully – they explain exactly what you need to do for each program.



## ANY PROBLEMS?

If you need help with any of the software this month, please send an email to [support@creativemark.co.uk](mailto:support@creativemark.co.uk). We check this inbox regularly. Please include the issue number of the magazine and your coupon code.

## NO CODE?

In order to use the unique code printed on the spine, you must buy the £4.99 'Free Software' print version of the magazine. If you have this edition and still don't have a code, please contact [letters@computershopper.co.uk](mailto:letters@computershopper.co.uk).

**REGISTER YOUR SOFTWARE  
BY 19th NOVEMBER 2020**

## Softmaker Office NX Home 2021

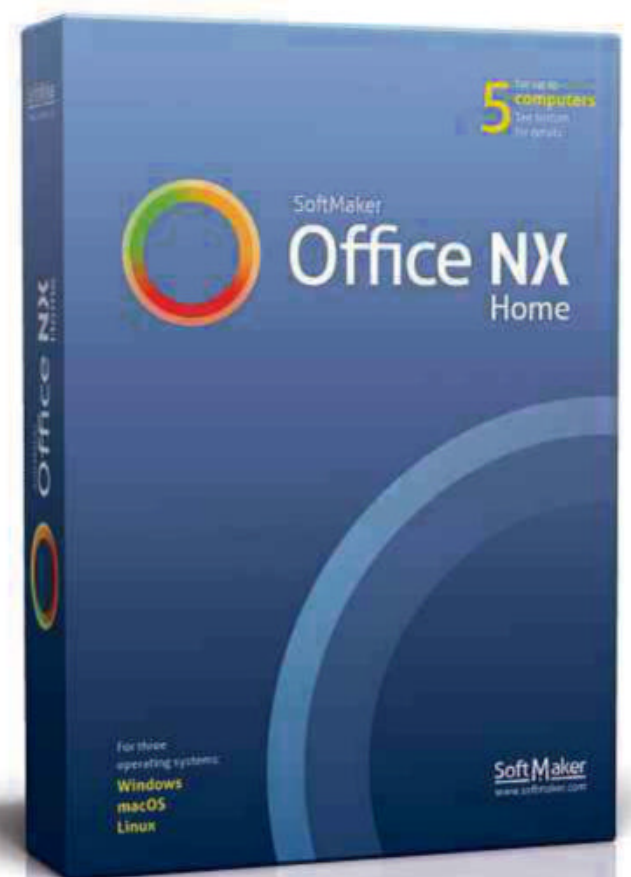
**OFFICE NX HOME** is a powerful productivity suite, providing an alternative to Microsoft Office while keeping compatibility with its key file types.

The package includes a word processor (TextMaker), spreadsheet (PlanMaker) and presentation tool (SoftMaker), and each of these can open both the old-style and Office 365/2010 files for their equivalent Microsoft application (DOC and DOCX, XLS and XLSX, PPT and PPTX, and so on). Conversion is reasonably accurate, too, although there are occasional problems with more complex documents.

If you're not a fan of the Microsoft Office UI, then the SoftMaker Office interface may appeal, as it offers a classic style for the more conventional menus and toolbars (a ribbon is available as an option). You also get the standard Microsoft Office flat-designed theme interface if you prefer this instead. There's even a dark UI to match Windows 10's dark mode.

The suite also has plenty of useful extra features, including a handy Export to PDF option on every File menu, and the ability to be installed on a USB flash drive.

The commercial version of Office NX Home gives you a whole host of additional features in comparison to the Free version.



We're offering you a whole year's subscription to Office NX Home to take advantage of the additional content.

**REQUIREMENTS** Windows 7, 8 or 10; 300MB hard disk space  
**WEBSITE** [www.softmaker.net](http://www.softmaker.net)  
**NOTES** Get your registration code at [softmaker.com/go/nxcs](http://softmaker.com/go/nxcs). Includes a one-year subscription





# Abelssoft Find My Files 2020

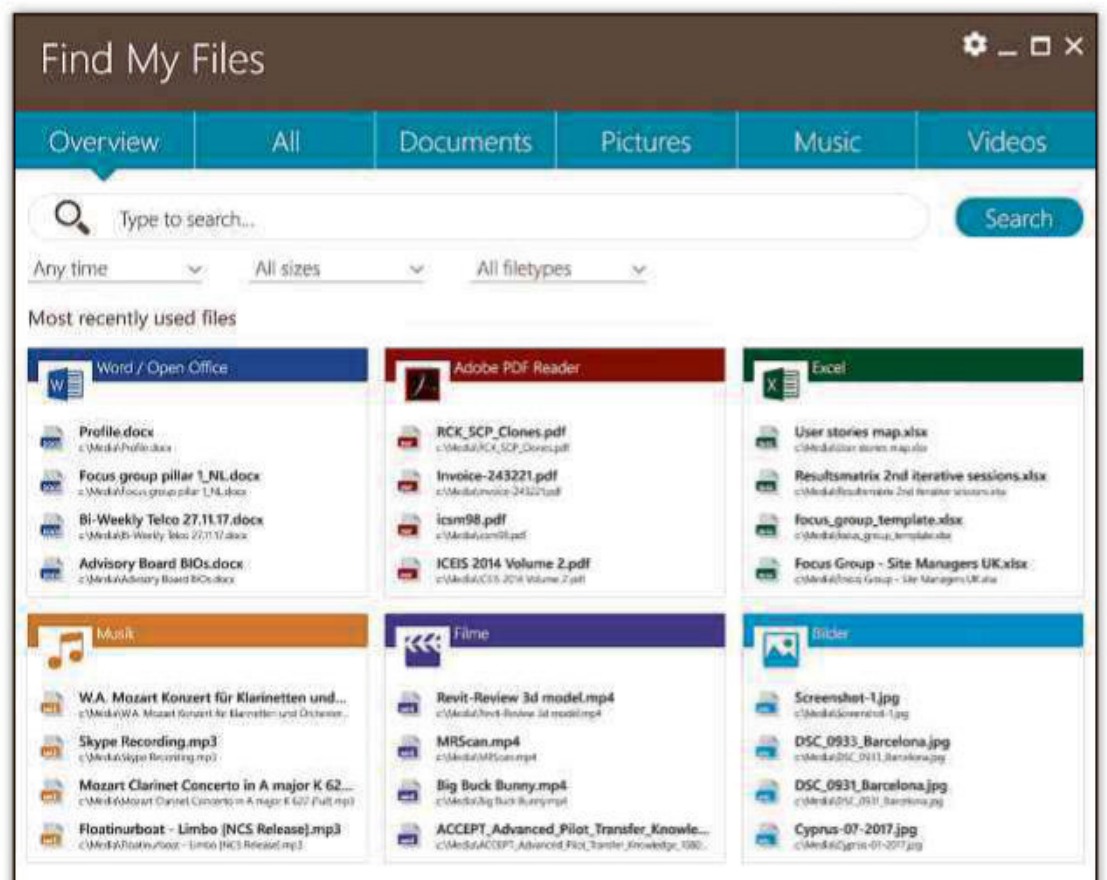


**FINDING INDIVIDUAL FILES** buried deep within a stuffed storage drive can be difficult. Windows and macOS both include a search function to find files quickly, but both have their limitations. You also might want to search for a group of files based on type or original application.

Find My Files is a simple tool designed to make finding your files and folders faster and easier.

For example, say you want to find Adobe Acrobat files on your system: Find My Files groups these together to display both the location and area stored on your drive. If you want to drill down even further and find one particular PDF, simply insert the keyword and the results will be displayed instantly.

You can also use Find My Files to locate all the photos stored across various folders on your hard



disk or SSD, and do the same for your music and videos. If you want to find a particular photo, such as a JPG, you can add a filter to narrow the results, and you can even search for files based on size, just in case you wanted to use Find My Files to delete unnecessary large files.

**REQUIREMENTS** Windows 7, 8 or 10;  
50MB hard disk space  
**WEBSITE** [www.abelssoft.net](http://www.abelssoft.net)  
**NOTES** Get your registration code within the application

# ASCOMP Secure-PDF 2020

**THE PDF FILE** is now ubiquitous, but many people don't look beyond the very basics of what the file format has to offer. While it used to be difficult to create PDFs, these days it has become incredibly simple thanks to the large number of free PDF 'printers' and Windows 10's support for the format. But while

free PDF creation and conversion tools are great, they often miss out on many of the security features the format offers.

Secure-PDF looks to address this by providing a quick and easy way to secure PDFs in a number of different ways. In addition to making it possible to password-protect documents with 256-bit

encryption, the program can also be used to add watermarks to files to discourage people from copying them or trying to pass them off as their own.

When encrypting documents, you have the option of not only setting an access password, but also placing limits on what people are able to do with a document. You can, for instance, prevent people from printing, editing or copying PDFs while allowing them to view them, complete forms, and add annotations. You can also limit the quality at which files can be printed.

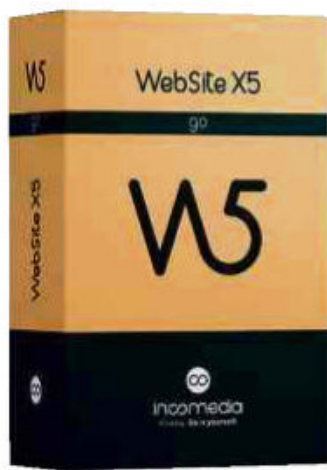
Adding a watermark is simple, and gives you an extra means of stamping ownership on a file you've created. While it is by no means a completely secure way of preventing documents being abused or stolen, it is a handy additional security measure.

On top of all this, Secure-PDF can also be used to digitally sign PDF documents, and apply owner information to documents you've already created.



**REQUIREMENTS** Windows 7, 8 or 10;  
100MB hard disk space  
**WEBSITE** [www.ascompsoftware.com](http://www.ascompsoftware.com)  
**NOTES** Get your registration code within the software





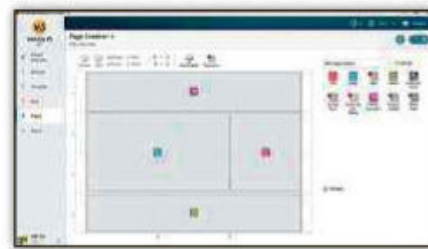
## WebSite X5 Go 2020

**WEBSITE X5 GO** 2020 is a powerful application that makes it easy to create top-quality responsive websites, even if you've got no design or coding experience at all.

The program offers a range of professional templates covering just about every site type and topic area, including e-commerce, blogs, sports sites, animals, food, movies, web portals and more.

Choose a design that appeals, and you can then start planning your site's structure using a map.

From here, it's simply a case of populating each page in turn by dragging and cropping various elements on to your page. Again, there are plenty to choose from, including text blocks, images, galleries, tables, video and audio widgets, maps, Flash



animations, product catalogues, email forms and more.

Each element can be styled in many different ways, for a more personal touch. WebSite X5 doesn't just embed an image, for instance; you can define a quality setting and

resize method, apply a host of smart mouseover effects (like zooming in and displaying custom text), and even use some basic protection to prevent a browser copying the image. Of course, if someone's truly determined to save it they'll quickly find some other way, but regardless, it's a convenient feature.

Your project may be previewed at any time, whether to judge its progress or to give it a final check over, or uploaded via a built-in FTP engine for more testing.

**REQUIREMENTS** Windows 7 SP1, 8, 10;  
300MB hard disk space  
**WEBSITE** [www.websitex5.com](http://www.websitex5.com)  
**NOTES** Register through the software



## Ashampoo Photo Optimizer 2020

**ASHAMPOO PHOTO OPTIMIZER** is an easy-to-use tool for tuning and fixing your digital images.

The program takes an app-like approach to photo tweakery. There are no selection tools, no drawing or paint options, no floating toolbars: you just select one or more photos and apply your effects in a click or two.

Tools on offer include the usual Crop, Resize, Rotate, Mirror, Sharpen, Blur and Straighten options, and there are automatic adjustments for brightness, contrast, hue, saturation, and gamma.

These individual effects are quite basic. You can't choose your resize algorithm, or correct contrast with a bezier curve: mostly you have just a slider or two.



Despite that, there are some neat touches. The Crop tool supports common aspect ratios, a neat Straighten Horizon option provides two points that you can simply click and drag to positions on the real horizon, images are auto-rotated based on their EXIF orientation, and

metadata is preserved when saved.

What's more, you don't have to manually edit your images at all. An Auto Optimize tool can fix an entire folder of photos in a single click, while a smart Preview feature helps you check the results.

Whatever you're doing, the finished images may be saved in a few core formats (JPG, PNG, BMP, TIFF, JNG), exported as emails or printed.

**REQUIREMENTS** Windows 7, 8, 10;  
150MB hard disk space  
**WEBSITE** [www.ashampoo.com](http://www.ashampoo.com)  
**NOTES** Get your registration code within the application



## F-Secure SAFE 2020

**F-SECURE SAFE 2020** is a mid-range security suite that can protect Windows and Mac desktops, as well as up to two Android and iOS devices.

While the range of tools it includes is relatively lightweight, this isn't necessarily a bad thing as it means you receive a fast security suite that focuses on protecting your devices. The program uses minimal system resources, and is extremely simple to use.

Independent testing shows that F-Secure's protection is worth having, too. The previous engine is ranked third out of 25 at AV-Test, just behind Bitdefender and Avira. With F-Secure developed in Finland, you can be assured that its servers are locked down and audited by the EU if recent news about other security manufacturers has left you feeling nervous and seeking a brand-new solution.

SAFE 2020 includes powerful parental controls, enabling you to configure

security for the entire family. You can configure SAFE for yourself or allocate a device to another user, and using a secure online account, configure the time they can access the internet or pick and choose the types of website you want them to visit.

There's improved mobile support, too, in particular with the program's simplified anti-theft tools. Android and iOS users can now remotely locate, lock, reset, wipe or sound the alarm on a lost or stolen device, all from F-Secure's own web portal.

It's worth noting that F-Secure SAFE has a flexible licensing policy. You can choose which devices you want to protect (up to two in total with this licence), but unlike rival security suites, you can allocate a licence to another person entirely of your choosing. This could be another family member or simply a friend – the choice is yours.



**REQUIREMENTS** Windows 7, 8, 10, macOS, iOS, Android; 150MB hard disk space  
**WEBSITE** [www.f-secure.com](http://www.f-secure.com)  
**NOTES** Register at [safe2020.disc.computershopper.co.uk](http://safe2020.disc.computershopper.co.uk). Be sure to read the instructions in full. Includes a two-device, one-year licence



## Chat and Communication

**Evernote 6.25.1.9091** Store your notes, ideas and plans in the cloud, and synchronise them between computers.

**Mailbird 2.8.30.0** A free desktop email client for Windows.

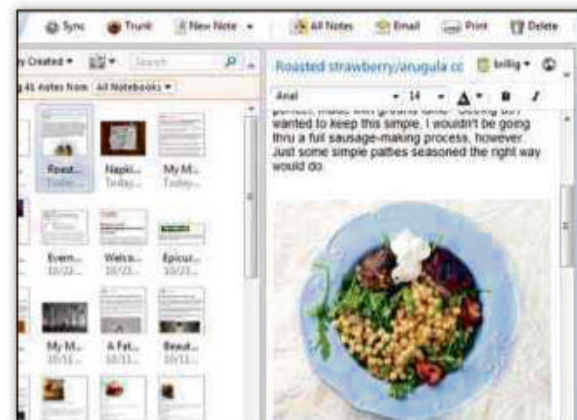
**Miranda IM 0.10.80** Chat with friends across multiple messaging platforms, including AIM, Facebook, IRC and MSN, all from one simple interface.

**UPDATED Skype for Windows 8.64.0.80** Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

**UPDATED Telegram 2.3.1** This free IM app syncs your conversations across multiple devices, and can spruce up chats with stickers and GIFs.

**WhatsApp Desktop 2.2033.7**

A PC and Mac version of the messaging app, letting you chat from your desktop.



## Customisation

**UPDATED iolo System Mechanic Free 20.5.1.109** Speed up your system with iolo's PC optimisation suite.

**Rainmeter 4.3.1**

Customise the desktop with your choice of tools and shortcuts.

**Windows 8 Transformation Pack 9.1**

Emulate the look of Windows 8 on an earlier version of the operating system.

**Windows 8 UX Pack 9.1**

Get a glimpse of the Windows 10 UI without committing to a full OS upgrade.

**Windows 10 Transformation Pack 7.0**

Bring some of Windows 10's new features to your current operating system.

**Winstep Xtreme 19.2**

Freshen up your system with this suite of desktop and UI replacement applications.



## General

**Genie Timeline Free 2017 10.0.1.100**

Protect your most valuable files with this easy-to-use backup tool.

**Paragon Partition Manager 16 Free**

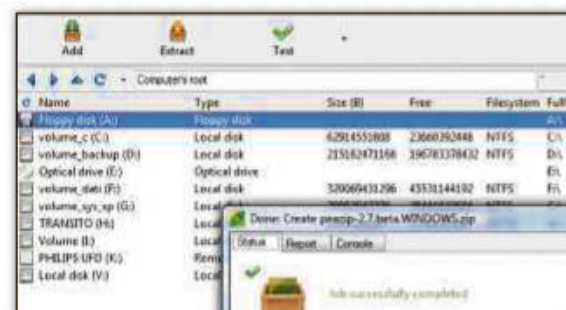
Create, format, split, merge and reorganise all your hard disk's partitions.

**UPDATED PeaZip 7.4.1** An extremely powerful archive-management tool.

**Screenshot Captor 4.36.2** Create and manage screenshots the easy way.

**UpdateScanner 2.2.0.0** Scan all the software on your PC, find out if an update is available, then install it immediately.

**ZipGenius 6.3.2.3116** A flexible file-compression tool with support for a huge number of compressed file formats.



## Internet and Network

**CarotDAV 1.15.9**

Manage all your online storage services with one simple application.

**UPDATED Cyberduck 7.6.0**

A powerful but easy-to-use FTP client for uploading and downloading your files.

**Glasswire 2.2.210.0**

Keep tabs on your network usage with this simple monitor.

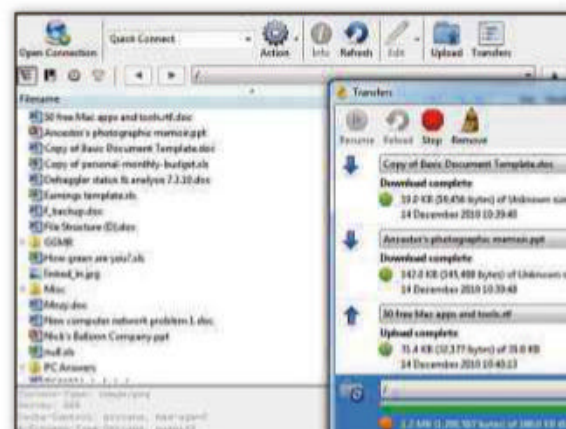
**UPDATED FileZilla 3.50.0** A fast and reliable FTP client with lots of useful features.

**UPDATED NetBalancer 10.1.3**

Make the most of your internet connection by assigning download and upload priorities to web applications.

**UPDATED TeamViewer 15.9.4**

Remotely control your computer from anywhere in the world.



## Tweaking and Performance

**CCleaner 5.70** Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

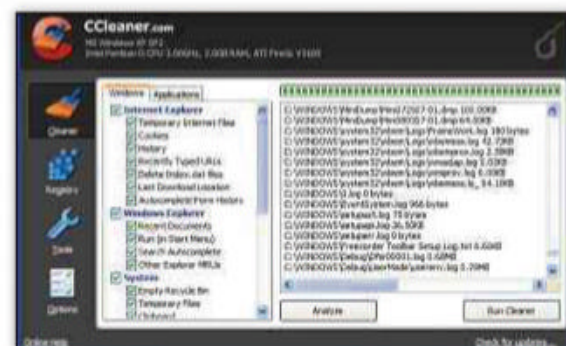
**Defraggler 2.22** Ensure that your system is defragmented properly and improve its performance.

**Finestra Virtual Desktops 2.5.4501** Set up four or more virtual desktops on your PC.

**UPDATED IObit Advanced SystemCare Free 13.7.0.303** A complete computer security, maintenance and optimisation suite.

**Revo Uninstaller Free 2.1.7** Remove installed applications completely, including all their folders, system files and Registry entries.

**Simple Performance Boost 1.0.5** Tweak the Windows Registry to give your PC a performance boost.









# CHANGING TUNE SPEAKERS

If your smartphone or laptop speakers don't cut it, it's time to add a dedicated speaker to the mix. With options ranging from portable, weatherproof models to versatile smart speakers, there are plenty to choose from

**I**t doesn't take the well-honed ears of a professional musician or sound engineer to know when a set of speakers is holding back the quality of music and video. You've probably experienced this yourself, playing through the integrated speakers on a phone or laptop and immediately noticing it lacks the richness and impact that might have been possible with headphones – or, indeed, a better speaker.

With that in mind, we've gathered up nine speakers to see which are the most worthy upgrades from tinny built-in drivers. They can all connect via Bluetooth, so will work with a wide range of devices and operating systems, but beyond that they're a diverse bunch: portable, battery-powered speakers, stylish and high-powered living room speakers and smart speakers with digital assistants are all here.

## SHAKE DOWN

Where sound quality is concerned, perhaps the most important components of a speaker are the drivers: small cones that vibrate to produce soundwaves. →

## CONTENT REVIEWS

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**AMAZON** Echo Dot with Clock

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**B&O** Beosound A1 (2nd Gen)

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**BLUESOUND** Pulse Flex 2i

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**GOOGLE** Home Max

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**HARMAN KARDON** Citation One MKII

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**JBL** Boombox 2

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**NAIM** Mu-so Qb 2nd Generation

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**SONOS** Move



Generally, speakers with multiple drivers can better reproduce a wide frequency range, as woofer-type drivers and tweeter drivers can focus on bass tones and high-frequency notes in particular. This is why a lot of larger speaker units are fuller-sounding than little ones: larger drivers and woofers are better at producing low and mid-range tones, while small drivers might be good for high notes but struggle to vibrate slowly enough for lower tones without losing volume.

This doesn't mean speakers with just one driver will sound bad – in fact, the Echo Dot with Clock (page 67) sounds great for such a compact and cheap model – but it's easy to get better results with at least a couple of drivers, especially if they're of different types. Depending on how the drivers are oriented, you might also get to enjoy a stronger 360° effect where the sound is dispersed in multiple directions – useful if you want to cover a large area in your home or garden. Although many manufacturers don't reveal the power of their speakers, something with a higher wattage will also be better at filling big spaces, as higher power output means higher volumes.

### CABLE MANAGEMENT

Taking your speaker further afield will naturally require it to be battery-powered; fully wireless, in other words. Although all the speakers we're covering here support Bluetooth connectivity, many require a mains connection, so are only 'wireless' in the source-to-speaker aspect.

If you don't know if you'd prefer a wireless or mains-powered speaker, consider the benefits and limitations of each. Using battery power will let you use your speaker anywhere, not just places where a wall socket wouldn't be available, such as in a park or at the bottom of a large garden, but also where it might not be wise to trail a wire around, such as your bathroom. However, you'll be at the mercy of the remaining charge, and even the longest-lasting battery speakers can run dry after two days of heavy usage. That's something to bear in mind when, say, going on holiday.

Wired speakers lack such portability, even if they're physically small, but by leaning into housebound nature they can offer a greater range of connectivity and larger, more



powerful drivers than they would if they were balancing the need to save on dimensions and weight. It's also very rare to see Wi-Fi-enabled features – like digital assistants and built-in music streaming – on portable speakers, as they're much more likely to be removed from spaces with a consistent Wi-Fi connection.

### WARM AND DRY

However, portable speakers are likely to be more robustly built, with many including protection against dust and water ingress. Again, that's valuable if you want a speaker to enjoy in the bath, or just as a precautionary measure to prevent damage by sudden rain showers when you're listening outdoors.

Look out for whether a speaker has an IP rating, for which it must meet certain standards of protection against the elements. Its degree of protection is denoted by two numbers in the rating, for dust and water resistance respectively: an IP57 rating, for example, means the speaker blocks dust well enough to prevent its operation being affected, and that it can survive full submersion in up to one metre of water for up to 30 minutes. An IPX7 rating, meanwhile, shows that no dust resistance is present, but that the device is still waterproof to that 1m depth.

### THE AUDIAL NETWORK

Regardless of whether you choose a hardy portable speaker or something more refined for your living room, you should be able to connect quickly and easily via Bluetooth; a

✦ Consider battery life if you want to take your speaker out and about

lot of speakers have accompanying mobile apps available, but these are rarely necessary except for setting up.

Alternatively, you may be able to plug in a source device via cable, for a more reliable connection without any of that signature Bluetooth hissing: 3.5mm auxiliary inputs are common, and some even have a USB port so you can play music from a flash drive.

For the most extensive feature set, however, you'll want a speaker with Wi-Fi – or an internet connection via Ethernet, if the speaker includes the appropriate RJ45 port. This unlocks a wealth of new tricks, from the ability to stream internet radio or Spotify songs to multiroom capability, in which your speaker can link to others for synchronous playback throughout your home.

### LITTLE HELPER

You'll also need an internet connection if your speaker is smart, meaning it's equipped with a digital assistant such as Amazon's Alexa or the Google Assistant. Almost all the models here aim to be great speakers first and smart home devices second, but the possibilities are fairly consistent: once the assistant is set up, you can make vocal commands to make requests (such as asking for the weather forecast or setting a reminder) or control other smart home devices on the same network, such as light bulbs and thermostats.

This clearly makes smart speakers a lot more multitalented, although that doesn't always mean they're the best ones to buy: you need existing smart home hardware to make use of one as a controller, and even if you buy one of the few smart portable speakers (such as the Sonos Move), it will lose those smarts once you're out of Wi-Fi range. As we said, most of these speakers focus on core audio quality over smart features, but consider whether you'd actually use the latter before making it part of your desired criteria.

## Bluetooth versions explained

Not all Bluetooth connections are made equal: the version supported by a speaker can meaningfully impact how it operates, especially if it's a fully wireless, battery-powered model.

Don't assume everything uses the latest version, either. In fact, most speakers, as well as many laptops and smartphones, still use Bluetooth 4.2, a version that first launched all the way back in 2014. 4.2 was, in fairness, designed for devices much like wireless speakers: it made improvements to version 4.1's networking protocols that allowed for individual devices to have their own IP address, and could transmit data about two and a half times faster than 4.1. The more recent Bluetooth 5, however, is even faster, while



drastically improving range and power efficiency – resulting in, among other things, Bluetooth speakers that could be taken further away from a source device and won't drain the battery as quickly. The version 5.1 upgrade then went on to enhance power efficiency even further, and improved how a device makes itself available for nearby devices to connect, potentially making for quicker and more stable pairing.

In short, a speaker with Bluetooth 5.1 has several practical benefits over one that uses version 4.2 or 4.1.

It should be said, however, that none of these is pertinent to sound quality; this can be affected by the quality of the Bluetooth codec being used, but not by the version per se.



# AMAZON Echo Dot with Clock



£35 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

The new Echo Dot takes a brilliant little Alexa speaker and adds a clock. What's not to like?

**THE HISTORY OF** Amazon's own products – misguided attempt at a smartphone aside – is one of small iterations. Whether it's Kindles, Fire Tablets or Echos, each new version brings small improvements that you probably weren't aware you needed until they arrived. The Echo Dot with Clock is a great example of this. It's not strictly an essential upgrade from the standard Echo Dot (*Shopper 378*), but it does completely fix one of its problems.

You see, the Echo Dot can be a handy tool for your bedside table: it can play soothing music to help you drift off, or turn on smart light bulbs when you need to get up. To simply check the time, however, you must ask Alexa out loud, then have it spoken back to you. That's not ideal if you share a bed with someone, or have thin walls and neighbours who don't appreciate your 3am smart speaker chinwags.

You could have a separate digital clock, but the appropriately named Amazon Echo Dot with Clock kills two birds with one stone by displaying the time in bright LEDs across its side. The built-in clock can also show timers, the current playback volume level and the temperature outside.

## TAKING MINUTES

The clock is, admittedly, the only difference between this model and the regular Echo Dot, and when switched off it looks identical. It has the same small yet chunky 43x99x99mm dimensions of the previous speaker, is still purely mains-powered and sticks with the fabric cover, which wraps around the sides.

It's only when you plug it in that the new change becomes apparent, as underneath that fabric is the segmented LED display. It won't be displaying advanced graphics or video, like an Echo Show 5 (*Shopper 380*), but it works well, and adapts its brightness to meet the needs of the room.

On that note, the Amazon Echo Dot with Clock isn't only useful in the bedroom, although we like how alarms can be silenced by touching the top, like a snooze button. The timer functionality also comes in very useful for cooking in the kitchen, as unlike with other smart speakers, you can tell how long is left at a glance instead of having to ask.



Knowing what the temperature is outside is less essential, but it's nice to have anyway.

Again, you're not getting the flexibility of a smart screen device like the Echo Show 5 or the Echo Spot, which is also based on an alarm clock, but then the Echo Dot with Clock represents a workable middle ground. It's better at providing at-a-glance information than the standard Echo Dot, without the higher price and greater size of a smart screen.

Sound quality is unchanged from the Echo Dot, but that's good news. While previous generations had pretty thin, tinny sound, which was good for audiobooks but not much else, the third and current generation fixed that with performance that's much more in line with what you'd expect from a company with Amazon's stature.

## THAT SOUNDS FAMILIAR

Putting the standard 3rd-gen Echo Dot and the clock version side by side, and alternating the same track between them, the two are indistinguishable, with surprisingly resonant

bass response and a reasonably rich music playback across the frequency spectrum. You can even pair a couple of Echo Dots for makeshift stereo sounds, which improves things a touch.


That's not to overstate the audio fidelity, but it goes toe-to-toe with most dedicated Bluetooth speakers around the same (relatively low) price, which is a bit of a triumph when it does so much more. And, most importantly, it retains the 3.5mm audio jack output, so you can always plug it into a better-quality speaker if you buy one at a later date.

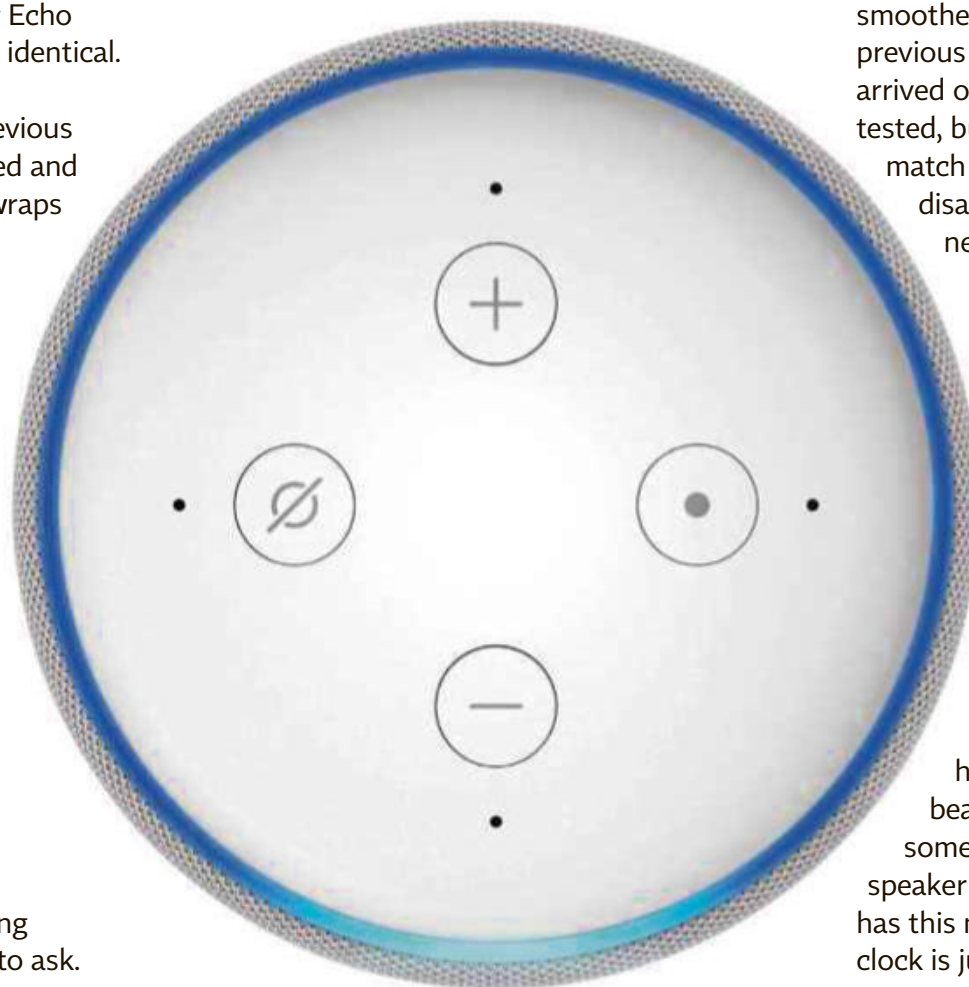
As for Alexa, it's business as usual here, which is unsurprising given that the smart assistant lives in the cloud rather than locally. Any advance in intelligence would hit all Echo devices at the same time. Google Assistant remains far better at answering questions and hearing what you're saying clearly, but for the basics, Alexa is just fine: ably playing music, radio and podcasts, connecting with smart home gear and telling you about your day.

We also noticed Alexa has an updated, smoother-sounding voice compared to previous Echo speakers. Oddly, this hasn't arrived on any of the other Echos we've tested, but hopefully they'll change to match eventually. It's not a huge disadvantage if they don't, but the new voice is a bit easier on the ear.

## ABOUT TIME

In short, the Echo Dot with Clock is everything you'd expect it to be, and has the same pros and cons as before. The LED display is extremely welcome, offering little details without detracting from the screen-free charm smart speakers were supposed to offer in the first place.

Alexa still isn't as good as Google Assistant, but in terms of hardware, the Echo Dot comfortably beats the Google Home Mini, so until someone puts Google Assistant in a dinky speaker with a 3.5mm audio jack, Amazon has this market pretty much sewn up. The clock is just icing on an already delicious cake. 







## B&O Beosound A1 (2nd Gen)



£199 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

The redesigned Beosound A1 improves on its predecessor in almost every way

**THE BEOSOUND A1'S** progenitor, the Beoplay A1, was an impressive combination of stylish design and top-quality sound. The 2nd-gen model might look nigh on identical to its predecessor, but B&O has made a number of tweaks under the hood to produce a speaker that's even better than before.

The disc-shaped A1 still resembles a UFO but it's now an imperceptible 1mm shorter, and at 558g it's 42g lighter. Those aren't dramatic changes, but there's no denying the A1 remains easy to carry around, especially with its adjustable leather carrying strap.

The Beosound A1 is dust- and waterproof thanks to its IP67 certification, which means it can be immersed in up to 1m of water for 30 minutes. Although B&O says the original was dust- and water-resistant, it lacked an official rating, and the inclusion this time around makes the A1 a more rugged prospect. There's no more worrying about dropping it in the bath or getting caught out in a thunderstorm.

### CONTROL YOURSELF

The Beosound A1's controls have also been repositioned to be more visible, and they're a doddle to navigate. There are no protruding buttons: instead, buttons integrated into the speaker's base provide a decent amount of feedback when pressed. **Play/pause** and **volume up and down are located on one side**



of the strap, with the power, Bluetooth and microphone buttons on the other side. An LED under the speaker grille indicates whether the A1 is turned on and, though rather small, it does the job well enough. It had previously been positioned on the side of the base and is now more visible, which is a big plus.

Battery life has received a big boost as well. The original A1 managed up to 24 hours while playing audio at low volume, while on the new model you'll get up to 43 hours at low volume and 18 hours of playtime at moderate levels.

Connectivity has also been upgraded: the A1 now uses Bluetooth 5.1 connectivity rather than 4.2, so it takes advantage of the newer standard's improved energy efficiency and Bluetooth range. We had no issues with the connection during testing: it remained stable at reasonable distances and through walls.

There's now support for both the AAC and aptX Adaptive codecs. The lack of support for higher-quality codecs was the only significant complaint we had about the original, so the fact B&O has addressed this is great to see.

### CALL FOR ASSISTANCE

Possibly the most interesting addition to the new model is Alexa support; this makes it the first Bluetooth-only speaker to include the Amazon smart assistant. The lack of onboard Wi-Fi connectivity also means the speaker itself isn't natively smart, like the Sonos Move is, but it can transform into a smart, Alexa-connected speaker once it's linked to the Alexa account on your smartphone.

This means smart functions are only available while your phone is connected to your Wi-Fi and you're within Bluetooth range of the A1. Once enabled, the Beosound A1's three internal microphones are ready and waiting for your wake word. Because it's your phone processing your queries, there is a slight delay between giving your command and it being actioned, but we didn't find this overly restrictive.

The A1's three internal microphones also allow it to double as a speakerphone during calls. Clarity is good, and we had no trouble being heard when conversing via the speaker.

Most importantly, the Beosound A1 delivers in the audio department. Its 3.5in woofer and 0.6in tweeter are powered by two 30W Class D amplifiers, so it's no surprise to find it packs a decent punch. It's not going to start any house parties, but it can comfortably fill a room or two at full volume, and has a beautifully detailed, balanced overall sound.

For those who want to tweak the sound to their liking, the B&O app offers four listening modes – optimal, ambient, party and speech – in addition to the option to create your own EQ. And, if you're willing to splash out on two Beosound A1s, you can pair them to create a true stereo experience. Sadly, however, stereo pairing is generation-locked, so this model can't be paired with the original Beoplay A1.

It's also a shame that B&O has removed the 3.5mm analogue input of the original model. It wouldn't necessarily have had a huge amount of use, but it added some welcome flexibility.

### SOFT TOUCH

Even with the addition of full waterproofing, the Beosound A1 just doesn't feel as rugged and durable as the likes of the JBL Boombox 2. In fairness, that's a lot bigger and more expensive, but B&O's speaker lacks a certain toughness that most wireless speakers would benefit from. If a rugged build and hard-knock credentials are top of your list, you may want to look elsewhere.

Still, the Beosound A1 isn't badly designed; if anything, the repositioned controls and added waterproofing make it an improvement in this department, and the missing input port is disappointing, but not ruinous. By delivering exceptional audio in an eye-catching package, the Beosound A1 overcomes these minor issues and ends up as a very tempting premium Bluetooth speaker.



# BLUESOUND Pulse Flex 2i

COMPUTER  
SHOPPER  
RECOMMENDED



£299 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

The Pulse Flex 2i is a versatile wireless speaker, whose compact form belies a powerful sound

**THE PULSE FLEX** 2i is the most compact entry in Bluesound's latest generation of Pulse Bluetooth/Wi-Fi speakers. It's also the most budget-friendly, even if the £299 price doesn't look it, but it's a good-looking speaker that packs a serious punch.

Weighing 1.23kg, it's not a lightweight option, but, given that it's primarily a mains-powered speaker, that isn't an issue – in order to make it fully wireless, you'd need to buy the £69 BP100 battery pack. The large grille on the front of the speaker is all you'll see when looking at it head on, which gives the Pulse Flex 2i a no-nonsense, minimalist feel. That is reinforced by the choice of colours. The speaker is only available in white or matt black; you won't find any garish hues here.

## FINDS THE NET

The Pulse Flex 2i's main form of connectivity is Wi-Fi, specifically of the dual-band 802.11ac variety, so you'll be mainly streaming music to it over your home network. You can also connect your devices directly to it via Bluetooth, and the speaker supports the aptX codec as well as standard SBC. However, there's no support for aptX HD, which is available on both the top-spec Pulse 2i and the mid-range Pulse Mini 2i.

Located at the back of the speaker are a decent range of physical ports. There's Ethernet for hooking up directly to your router, a 3.5mm headphone out, analogue in, USB2 for FAT32- and NTFS-formatted memory sticks, and a Micro USB socket for servicing. Hidden behind a rubber bung is the connector used to attach the battery pack and a threaded socket that facilitates wall mounting with the Pulse Flex bracket.

In theory, the Bluesound Pulse Flex 2i is very easy to set up: download the BluOS app for either iOS or Android, connect to your Wi-Fi via the device you want to control your speaker with, and complete setting it up via the app.

In practice, however, this proved trickier than it should have been. It took us a few attempts to connect the speaker to an iPhone, and once the two had connected there were issues with updating the firmware; the speaker would continually get stuck in Upgrade Mode, causing it to disconnect. Only after connecting an Ethernet cable did setup proceed without a hitch.

Once you're up and running, you can set about adding your streaming services of choice to the app's UI.

There's a long list of services to choose from, including Amazon Music HD, Deezer, Napster, QoBUZ and Tidal. Spotify is also available, although you'll need a premium account and can only access playlists through the Spotify app, not BluOS.

In addition to the music streaming services on offer, you can access internet radio stations through a number of third-party platforms. There's Radio Paradise, which has four genre-specific playlists, TuneIn, which has a far more extensive selection of stations, plus a couple of services you can only access if you're in the US.

## FEELING BLUE

You can also connect to the Amazon Alexa or Google Assistant voice assistants, though both need to go through Bluesound's own voice-control interface, Blue Voice. This requires installing a set of Alexa Skills for Blue Voice or setting up an account via Google Assistant. Voice controls work well enough, but you'll have to retrain your brain to say 'OK Google, talk to Blue Voice...' when issuing commands. Both the Sonos One and Harman Kardon Citation One MKII integrate smart functionality more cleanly.

Within the app you can create playlists and presets, earmark your favourite songs, artists and albums, and tweak the speaker's settings. There are a pleasing number of settings to play around with, including the

option to change your output mode from stereo to left, right or mono, set a volume limit, adjust the bass and treble, and activate Bluesound's Replay-gain feature. When engaged, Replay-gain uses a track or album's metadata to provide consistent volumes

levels across said tracks or

album. It's a clever feature, but not one we felt particularly compelled to use.

When you're not using the app or remote, controls options are limited to the illuminated buttons on the top of the speaker, which let you select between five presets, play/pause music, skip tracks and control the volume.

## HIGHS AND LOWS

The Pulse Flex 2i houses a 25mm tweeter and 102mm woofer, and is powered by a 25W amplifier. The result is sound that belies the diminutive stature of the speaker. At maximum volume, the Pulse Flex 2i easily fills a large room.

Sound quality is good on the whole. While listening to a couple of Tidal's Masters playlists, the Pulse Flex 2i did justice to the majority of the Master Quality Authenticated tracks. Vocals and instruments were reproduced extremely cleanly, and the mids and treble dominating a range of indie ditties sounded spot on.

Bassier tracks didn't fare quite as well, sounding a little muddy, but dropping the bass level down a couple of notches in the EQ settings improved things. The soundstage felt rather narrow, but it didn't detract too much from what was otherwise a very enjoyable listening experience.

It goes without saying that if you're buying a wireless speaker with the intention of listening to high-resolution audio, you need to make sure your Wi-Fi can handle the streaming demands put upon it.

Assuming your home has a speedy and solid connection, we'd recommend the Pulse Flex 2i, especially if you can't quite stretch to the more expensive Sonos Move. It has a pleasing sound signature and can deliver seriously impactful hi-res audio while providing a wide range of streaming services and connections.





## DENON Home 250



£399 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

**This home speaker sounds great, but it launched without the promised smart functionality**

**DENON'S HOME 250** is one of a trio of new multiroom wireless speakers, sitting alongside the smaller Denon Home 150 and larger Home 350. With support for Spotify, Amazon Music HD, TuneIn, Deezer and more via Wi-Fi, plus AirPlay 2 and Bluetooth connectivity, it's a versatile and excellent-sounding speaker, albeit one that's yet to fulfil its potential.

Measuring 295x216x120mm, the Home 250 is a fairly sizable unit. Beneath the grille are four separate drivers – two 19mm tweeters and two 100mm woofers – which are accompanied by a 133mm passive radiator. Each driver has its own dedicated class D amplifier, and the speaker offers stereo playback, although this effect certainly won't be as prominent as it might with a dedicated two-speaker hi-fi system.

The speaker is covered by a water- and stain-resistant wraparound, meaning you should have no problems using it in your kitchen, and all controls are via a touch-sensitive panel on the top that lights up when you hover your hand over it.

### MISSING IN ACTION

The Home 250 also features far-field microphones for detecting voice command, but weirdly, the smart assistants that would use them aren't implemented yet. The speaker is on sale now, but Google Assistant and Alexa won't work on it until a firmware update later this year. This was the case when all three of Denon's new speakers first launched back in the summer, and disappointingly, the update in question has yet to materialise, and still doesn't have a more definitive release window beyond 'later in 2020'.

More positively, the Home 250 offers an impressive array of connectivity options. In addition to USB, 3.5mm and Ethernet ports, it delivers wireless music playback via Bluetooth and Apple Airplay. There's also out-of-the-box support for Spotify Connect and you can stream thousands of different internet radio stations via TuneIn using the speaker's accompanying Heos mobile app.

With no native virtual assistant currently available, you'll have to make do with linking Heos via the Alexa and Google Home mobile apps. However, this doesn't always offer the same level of functionality as you'd get with a built-in voice assistant. In the case of Google Home, for instance, there's no option to voice-search for music using Google Assistant on your phone or other

speakers, so you'll have to make do with basic controls such as play, pause, skip and volume.

Rather frustratingly, there's also no Google Cast option, so if you want to play radio from the BBC Sounds app, you'll have to do so via the TuneIn option in the Heos mobile app or by connecting the Home 250 to your phone via Bluetooth.

### WALL HUGGER

Denon claims the Home 250 sounds best when placed between 3in and 12in away from a wall, as close to ear level as possible. There's certainly truth in that; when placed in the middle of a room, music sounded much more boomy and the bass was less controlled. Ideally, however, a speaker this pricey would have adaptive room EQ, as found in Apple's HomePod, the Amazon Echo Studio and Sonos Move.

Having said that, we found the Home 250 still offered a largely enjoyable listening experience at a range of volumes, wherever it's placed. As you might hope for a speaker of its price, it has excellent presence, especially in the lower frequencies, and it can comfortably fill an open-plan living room with sound. Mid-range frequencies, too, sound detailed

and rich, and there's no unwanted distortion even when you turn the volume right up.

Treble is somewhat less prominent and, if anything, that adds to the overall pleasant, warm sound signature. Indeed, the speaker rarely sounds harsh in the way other single-unit speakers sometimes can. Should you want a brighter sound, you can easily adjust the equaliser to your own preference using the Heos app. It's only a simple EQ with levels from -5 to 5 for treble and bass, but that's probably enough to overcome any problems you might have with the speaker sounding too boomy when placed in the middle of a room.

If the Home 250 had launched with the promised digital assistants, it would be an easy recommendation. It's a pricey speaker, but the middle-sized Denon device offers superb connectivity and delivers a big, bold sound that can fill your home.

### UNFINISHED BUSINESS

Without the voice assistant, however, there's inevitably a temptation to look elsewhere. The Sonos Move, for instance, is a superb-sounding multiroom speaker that comes with support for both Alexa and Google Assistant.

A sooner-than-expected £50 price drop brings the Home 250 to price parity with the Move, but the Sonos speaker remains better overall.

Alternatively, if you're an iPhone user, the Apple Home Pod has recently been slashed to just £200, meaning you could buy two, run them in stereo and still have change to spare. It lacks Google Assistant and Alexa, but so does the Denon (and Siri is better than nothing).

It's a shame really, because the Denon Home 250 doesn't really do an awful lot wrong, but there are simply other products that do more for less, especially while we're waiting for that firmware update.





# GOOGLE Home Max



£199 • From [store.google.com](https://store.google.com)

## VERDICT

The Google Home Max is a big beast of a smart speaker that's finally become good value

**IT'S POSSIBLE THAT** the Google Home Max is not long for this world. Google recently chopped its price to £199, making it a full 50% cheaper than it was at launch, and this could be a sign of it being replaced by a new premium speaker, probably with Nest branding, much as the Google Nest Mini supplanted the Home Mini.

However, this is also cause to be happy, as the main issue with the Home Max has always been its high price. Now, not only is it drastically more affordable in general, it's also on level terms with the rival Apple HomePod, making comparisons between the two a little more favourable than they were when the Home Max cost more.

## BIG MOUTH

The Home Max is a much more substantial smart speaker than the rest of Google's range, weighing 5.3kg, but this comes with the sort of build quality you'd expect from a top-quality speaker. Give it a rap with your knuckles and it feels tight, solid and totally resonance-free.

Not everyone will love its slightly cutesy look, but the control scheme is a nice blend of minimalist design and straightforward functionality. Four circular LED dots lurk beneath the cloth grille on the front of the speaker, indicating various statuses, lighting up when the speaker is listening to you and showing volume levels when you make adjustments. A touch-sensitive area on top of the speaker allows you to do just that, sliding your finger right and left to increase or reduce the volume, and tapping it to pause and play.

At the rear, meanwhile, is a switch for muting the microphone and a small cutout hosting the speaker's various connections: a figure-of-eight mains port, a 3.5mm audio input and a USB Type-C socket. The latter is used not for audio, disappointingly, but for connecting an Ethernet adaptor (which isn't included) in case you're having problems with Wi-Fi connectivity.

The Home Max is also flexible when it comes to connectivity. In addition to Wi-Fi, it's also possible to play music to the speaker via 3.5mm analogue and Bluetooth. To achieve the latter, you first have to put the speaker into pairing mode via the Google Home app, which is a bit of a faff, and there's no support for the aptX codec.

The Home Max's digital assistant features are familiar. Via Google Assistant, you can use your voice to ask the Home Max to play music

and radio; set up timers, reminders and calendar entries; and ask questions about the weather and various other trivia.

There's nothing new here, so if you're primarily concerned with smart features over audio quality, it might make more sense to buy the cheaper Home/Nest speakers. Still, Google Assistant remains excellent: it's much better than Alexa and Siri at recognising your voice and responding to follow-up queries. Its only weak spot is that Alexa is more widely compatible with smart home kit, thanks to Amazon's Skills feature.

Google Assistant is at least much better than Siri (and on a par with Alexa) when it comes to support for music and radio services. Whereas on the Apple HomePod you can only really use Apple Music if you want to search for music or podcasts by voice, the Home Max allows for full voice search, control and playback via Google Play Music, Spotify (Premium and free), Deezer and YouTube Premium.

## ONE TO TALK

Radio playback comes via TuneIn and iHeartRadio, while podcasts are played via Google's own library. There's no synchronisation between progress on the speaker and your phone, however, which is slightly annoying.

The Home Max's far-field microphones also have trouble when the music is turned up; the six-mic array is fine at picking up commands with moderate background noise, but when the speaker was at 60%

volume or higher we had to raise our voices far more often than with the HomePod or any of the Amazon Echo family.

That's not the only thing the Max uses its microphones for, however. Like the Apple HomePod, Google Home Max uses them to sense its surroundings and adapt the sound output automatically. Called Smart Sound, the idea is to avoid the boomy bass caused by placing speakers close to walls and in corners, or the lean, bass-light sound you can get from a speaker in a large, open space.


Sadly, unlike the HomePod, we didn't notice any significant changes when moving the Home Max to different positions. The most noticeable was when we put it deep into a corner, upon which the bass became more pronounced, but that's about it.

Luckily, this is a speaker that excels at the lower- and mid-ranges, regardless of where you put it. The two 4.5in woofers and dual tweeters provide controlled, deep bass and wonderfully rich mids, all with the potential for truly awesome volume: this speaker could easily cater for an entire house party, without distortion.

It falls short in the higher frequencies, however. This is particularly clear when playing live tracks, which lack their ideal atmosphere and presence, and the relatively slim soundstage doesn't help. The HomePod sounds far wider and deeper, especially compared to when the Home Max is laid on its side or up on its end.

## MAXIMUM VALUE

These sound quality weaknesses are, it should be said, counterbalanced by many good reasons to choose the Home Max. It's very flexible in terms of connectivity and supported streaming services, and Google Assistant works very effectively for the most part.

Then there's that price drop, which makes the Home Max much more competitive even in what could be its twilight months. Perhaps not enough to outshine the Sonos Move or Harman Kardon Citation One MKII, but this is a speaker that's become better with age. 





# HARMAN KARDON

## Citation One MKII



£180 • From [www.harmankardon.co.uk](http://www.harmankardon.co.uk)

### VERDICT

**A quality Google Assistant-based smart speaker, albeit one that might prove too bassy for some**

**THIS REVAMP OF** last year's Citation One – Harman Kardon's first Google Assistant smart speaker – makes it even smarter. The MKII addition might offer some additional colour options, but the big change is that it now supports Apple AirPlay.

Outwardly, the design hasn't changed at all. The Citation One MKII still has the look and feel of a premium speaker, largely thanks to the woollen fabric that wraps around the majority of the exterior, and while its 188mm height makes it slightly taller than the Apple HomePod, it's not too imposing a sight in your living room. It's reasonably heavy, at 2kg, but since it's a wired speaker with no battery, you won't be moving it around much anyway.

### STAY HOME

A clutch of touch-sensitive buttons sit on the speaker's top panel. These can be used to change the volume, mute the mic, turn Bluetooth on or off, play and pause audio, and activate Google Assistant. It's worth noting that a single press of either volume button won't do the trick; you have to hold your finger down, which we found mildly annoying. Still, it's not a massive problem, as you can simply use voice controls instead.

A small LED on the back of the speaker indicates Wi-Fi status, which will please those that position their speaker by the bed as it will prove less intrusive with the lights off. Four small LEDs are hidden under the fabric at the top/front of the speaker, which activate when Google Assistant is engaged or the touch-sensitive buttons are pressed. The power connector is tucked away on the bottom of the speaker with a little gap for the wire to pass through, so it sits flat on any surface, although there are also wall-mount and floor-stand accessories available.

You'll need the Google Home app to get set up, but doing so is very simple, thanks to a step-by-step guide provided in the box; even first-timers won't have any trouble. If you're already familiar with Google Assistant then you'll have it up and running, connected to your music service of choice and pumping out tunes in no time.

Its voice command options facilitate all the usual music controls – playing, pausing and skipping tracks, and changing volume – allow you to control your smart home appliances, access information from your calendar and find information online.

As per usual, Google Assistant proves better than Alexa for answering any search-

style queries you might have, although Alexa is still far more widely supported by smart home kit. Be wary about buying the Citation One MKII if you want your smart speaker to double as a controller for your lights or smart heating systems.

During testing, the speaker's two far-field microphones picked up commands consistently at a variety of distances. Even at maximum volume, it's not necessary to raise your voice too much to be heard – a stark contrast to the Google Home Max – and having Google Home's 'Lower volume when listening' option switched on meant the Assistant heard us clearly once we'd initiated a voice command.

### BASS CAMP

Harman Kardon's audio prowess is immediately evident with the Citation One MKII: it's a great-sounding speaker. Its 20mm tweeter and 89mm woofer are powered by a total of 40W of amplification, and put out a serious amount of noise when you start to crank up the volume. The speaker has the ability to fill a room with sound so effectively that it often feels like you're listening to something a lot beefier in size and power.

Vocals are crisp and well defined, full of rich body, while the presentation of both mids

and highs is hard to fault. Bass is a weakness, however: there's just a little too much of it. This might be fun with musical genres that thrive on thumping low-end, but for everything else it dominates the mix a tad too much. It becomes even more evident at higher volumes, where the speaker noticeably vibrates, although the general clarity remains uncompromised.

Sadly, there is no way to adjust the EQ levels in the Google Home app settings, so you're stuck with how it sounds out of the box. It's a real shame you can't tinker with the Citation One MKII's sound settings, as that would improve an already impressive listening experience. It can't tune itself to fit its physical surrounds either, something the HomePod has always done.

### GO TEAM

With the Citation One MKII, Harman Kardon has produced an aesthetically pleasing speaker than delivers great sound. It's unashamedly heavy on the bass, however, which we suspect will attract some while deterring others.

The addition of smart speaker functions makes the Citation One MKII a great option if you're looking to smarten up your audio at home, particularly if Google Assistant is already embedded in your ecosystem. It performs extremely well as a standalone speaker, but can also be used in conjunction with other members of the Citation family, which will be appealing to those craving multiroom control and a more complete home-entertainment experience.

It's not a speaker for those whose allegiances already lie with Alexa or Siri, but for anyone else seeking voice control and excellent audio quality, the Harman Kardon Citation One MKII is a strong choice.





# JBL Boombox 2



£400 • From [uk.jbl.com](http://uk.jbl.com)

## VERDICT

**Loud, bassy and rugged, the JBL Boombox 2 is a force to be reckoned with**

**THE BOOMBOX 2** is JBL's second take on the portable speakers that became cultural status symbols in urban areas during the 1980s and 1990s. Unlike the previous JBL Boombox (*Shopper* 369), it's an update rather than a complete reimagining, though there are plenty of small tweaks to go around.

## HOT WATTS

Power output, for instance, has been dialled up a notch, with the speaker's two drivers outputting 40W RMS each when plugged into the mains and 30W RMS when used on battery power. That's up from 30W and 20W respectively.

The battery size has been cut from 20,000mAh to 10,000mAh, although JBL still promises the same 24 hours of playback as the original. That's thanks to another upgrade: the more efficient Bluetooth 5.1 standard replaces the previous 4.2.

Sadly it's still limited to the basic SBC codec – there's no aptX or AAC support here – though you can connect to two Bluetooth devices simultaneously. IPX7 certification also makes a welcome return: it means the Boombox 2 can be submerged in one metre of water for up to 30 minutes. The B&O Beosound A1 can do the same, and has additional dust ingress protection, but on the whole the Boombox 2 just feels tougher and more durable, as is befitting of such an outdoorsy speaker.

In terms of looks, the Boombox 2 is very similar to the original, and that's no bad thing. Its cylindrical shape is a departure from the angular boomboxes of yesteryear, with the curvature giving it a more contemporary feel, while also making it less awkward to carry. The only real design changes from the first Boombox are new designs on the exposed passive bass radiators and a redesigned battery indicator.

Housed under a rubber seal on the back of the speaker are the connection ports: there's a Micro USB connector

for firmware updates, as well as a USB2 charging port, one 3.5mm aux input and the power connector. One of the strengths of the original Boombox was its ability to charge two devices at once, so why we now only get one socket for this is a bit of a mystery.

This new model is also much heavier. A full 650g heavier, in fact, despite only being a couple of centimetres wider. It's still not unbearably heavy – we could carry it on a shoulder or just gripped by our side without difficulty – but you wouldn't want to lug it around on long walks.

At least the handle has been improved. There's now a notched grip on the underside, inspired by motorcycle handlebars, and this gives a lot more purchase, especially if your hands are wet.

## BETTER WITH FRIENDS

The controls are pretty self-explanatory, with individual play/pause, power, Bluetooth pairing, volume up and volume down buttons. Alongside them is the PartyBoost button, which replaces the Connect+ button found on the original Boombox. The feature functions in exactly the same manner as Connect+: simply press the button and you can connect up to 100 (yes, one hundred) compatible speakers to each other, should you so desire.

It's annoying, however, that PartyBoost isn't cross-compatible with Connect+, nor the preceding Connect system. It's good that stability and connection range have improved with each generation, but the lack of backwards compatibility means the Boombox 2 can only link with itself, the Flip 5 and the Pulse 4.

Inside the Boombox 2, the driver setup mirrors that of the original, with two 4in woofers and two 20mm tweeters. However, where the original Boombox had indoor and outdoor modes, the latter boosting your bass to borderline obscene levels, there's now just one setting for all environments. The enormous bass that characterised outdoors mode hasn't been downgraded – you're still able to feel its power surging through you when in close proximity – but the sound is better balanced across the full audio spectrum.

The Boombox 2 has also fixed the old model's problems with a lack of detail in its treble representation, as well as vocals getting lost in the prominent low end. At maximum volume, it's easy to become distracted by the ground-shaking bass, but unlike on the Harman Kardon Citation One MKII, it's not overpowering, as the highs come through clearly and with plenty of presence.

On AC power, the combined 80W of power is enough to make the Boombox 2 extremely loud, its output audible from over 100ft away. On battery power it's not quite as loud, but it will easily cope with a garden party or barbecue.

## BOXED TOGETHER

The Boombox 2 is a beautifully engineered beast of a Bluetooth speaker. The bass is outrageous in the best possible way and although you're now limited to just one sound setting, the speaker sounds great both indoors and out.

That said, if you have the original Boombox, it's hard to wholeheartedly endorse what is a pricey upgrade. Sure, you'll be getting futureproofing in the form of PartyBoost, a more stable Bluetooth connection, an improved handle and a slightly louder speaker with better overall audio quality, but £400 is a lot to pay when there's something sitting at home that fulfils the same role.

If, however, you don't own the first generation and are craving a speaker that will let you blast out music anywhere you want come rain or shine, then the Boombox 2 is well worth a look.





## NAIM Mu-so Qb 2nd Generation



£749 • From [www.johnlewis.com](http://www.johnlewis.com)

### VERDICT

The updated Mu-so Qb packs an astonishingly big sound into a stylishly small box

**NAIM'S BLUETOOTH SPEAKER** is back for a second go, and at first you'd be hard-pressed to spot the difference between the original Qb and this new model.

That's no bad thing, however: it's a lovely piece of brutalist design, with soft waves of the wraparound fabric cover serving to soften the Qb's stark, cuboid lines. One of the most welcome additions isn't even part of the speaker itself: a remote control, which saves you the bother of having to either keep your phone on hand to adjust the volume or change inputs, or to traipse over and make adjustments with the onboard controls.

### TRUSTED SOURCES

The huge illuminated rotary volume control is still present and correct, but it now has a proximity sensor and a new button layout. It lights up the moment your hand moves close by, and there are now buttons to cycle through and select more of the many, many possible inputs. You can tap the Bluetooth button to initiate pairing mode, dab the multiroom button to pair it with another compatible Naim device, or just wander over and tap the favourites or radio buttons to pick from your five favourite radio stations or Spotify playlists.

There are certainly plenty of sources to choose from. Besides 802.11ac Wi-Fi and Ethernet for general streaming, you can opt for a direct Bluetooth connection, and there's integrated support for Spotify Connect, Tidal, Roon and Chromecast 2 as well. All that is rounded off with a 3.5mm analogue input and optical S/PDIF input at the rear, which means it's easy to hook up to TVs, laptops or any device with an analogue or optical digital audio output.

Naim's app comes in both Android and iOS flavours. It's nicely versatile in that it can act as a touchscreen remote, input controller, multiroom speaker organiser and streaming source all in one, but it's not perfect. The interface takes some getting used to, and it's a shame it doesn't let you create playlists that combine local and streamed content. One remaining disappointment is that the Spotify button in the app only provides two options: you can resume playback from where you last left off, or launch the official Spotify app. That's your lot.

The better news is once you've got your music playing, the results are sensational. The Mu-so Qb's four hidden speaker drivers

and 300W of internal amplification have been tweaked and refined extensively, so compared to the first model, the slight thumpiness to the upper bass is entirely gone, and both the mid-range and upper frequencies sound noticeably clearer and more impactful. Bass remains outstandingly deep and forceful given the size of the speaker, but the more balanced frequency response means that it sounds deeper and more powerful as a result.

Everything from low bit-rate internet radio streams to hi-resolution audio files sounds fantastic through the Qb but, where lesser speakers tend to paper over the cracks between lossless streaming sources such as Tidal and those using compressed formats like Spotify, the Qb leaves you in no doubt as to the provenance of the music. Spotify sounds great, but flick to the same songs and albums on Tidal and there's a definite boost in punch and solidity, albeit a relatively subtle one.

### HOME COMFORTS

A big part of what makes the 2nd-gen Mu-so Qb sound so good is its added room compensation settings. Unlike the Google Home Max or Sonos Move, it doesn't use microphones to dynamically fine-tune sound output to its surroundings – instead you simply choose from options such as 'near wall' or 'near corner' – but it's still highly effective. Sit the Mu-so Qb close to a wall



without compensation turned on and the bass sounds tubby and ill-defined, but with the appropriate setting engaged, it instantly tightens everything up by assuming where the soundwaves will be bouncing. Thick, wallowy bass is thus replaced by a tight, punchy bottom end with plenty of extension.

If there's a weakness, it's one that's common to all single-unit speakers: you simply can't get a proper stereo image from one speaker. Apple, Sonos and others get around the problem by letting you pair two speakers together for stereo sound, but Naim hasn't designed the Mu-So Qb with this in mind. We actually tried pairing both the old and new speakers together, and the resulting setup reached terrifying volume levels far too easily.

Otherwise, this is a speaker that works the way you want it to. With wires or without; with the tap and swipe of a smartphone app or with the reassuringly old-school press of a button and flick of a volume knob; it's entirely up to you.

### ALL SQUARE

It's this versatility that permits the new Mu-so Qb to artfully channel a gateway from classic hi-fi through to the present day of elegant, effortless music streaming. That it does so with so little compromise – and in such a compact, stylish package – is something for Naim to be very proud of indeed.

Of course, at well over £700 it's nowhere near as affordable as the Home Max, nor indeed most standalone speakers. As such, it's exclusively a luxury purchase for audiophiles willing to spend big on the best possible sound quality. For most people, it simply makes more sense to choose the likes of the Sonos Move or Harman Kardon Citation One MKII instead, especially if you want smart features, but if you're lucky enough to have a spare £749, the Mu-so Qb is worth the investment.





# SONOS Move



£399 • From [www.currys.co.uk](http://www.currys.co.uk)

## VERDICT

It's heftier than most portable speakers, but the Sonos Move has the smarts and the audio quality to make up for it

**SONOS SPEAKERS HAVE** long been the benchmark for ease of use and sound quality in multiroom audio. But for almost as long, the company has point-blank refused to follow the rest of the industry in producing a mobile, battery-powered speaker with Bluetooth. With the new Sonos Move, however, it's finally relented, with both Alexa and Google Assistant on board.

The Move has departed from the bulk-buy, baked-bean tin look of previous models. Available only in Shadow Black, the new speaker is taller, with an oval top plate and a profile that tapers at the bottom end for a more elegant look. It's not a particularly radical design, but it is a good deal more attractive than the squat Sonos One (*Shopper 378*).

## JUST A TOUCH

All the main controls sit on the top panel, which also plays host to the speaker's far-field microphone array. The controls are touch-sensitive, which can sometimes spell trouble, but these work reliably and quickly; they comprise a microphone on/off button, a play/pause button and a pair of controls flanking that for adjusting the volume up and down.

At the rear is a scooped-out hollow containing the power button, the join button (for connecting the speaker to Wi-Fi or an existing network of Sonos speakers) and another button for switching between Bluetooth and Wi-Fi. There's also a carrying handle, which you'll need given the Move's considerable size and 3kg weight; this is definitely the kind of wireless speaker that's better for taking on short trips down the garden, rather than long excursions.

Even so, it's sturdy and well made, even meeting the IP56 standard for dust resistance and waterproofing. That doesn't mean you can dunk it in the bath, but it will shrug off a rain shower.

Battery life isn't bad, either, at 10 hours of continuous playback. The Move's battery is replaceable, too, although pricing and availability for spare units are yet to be revealed.

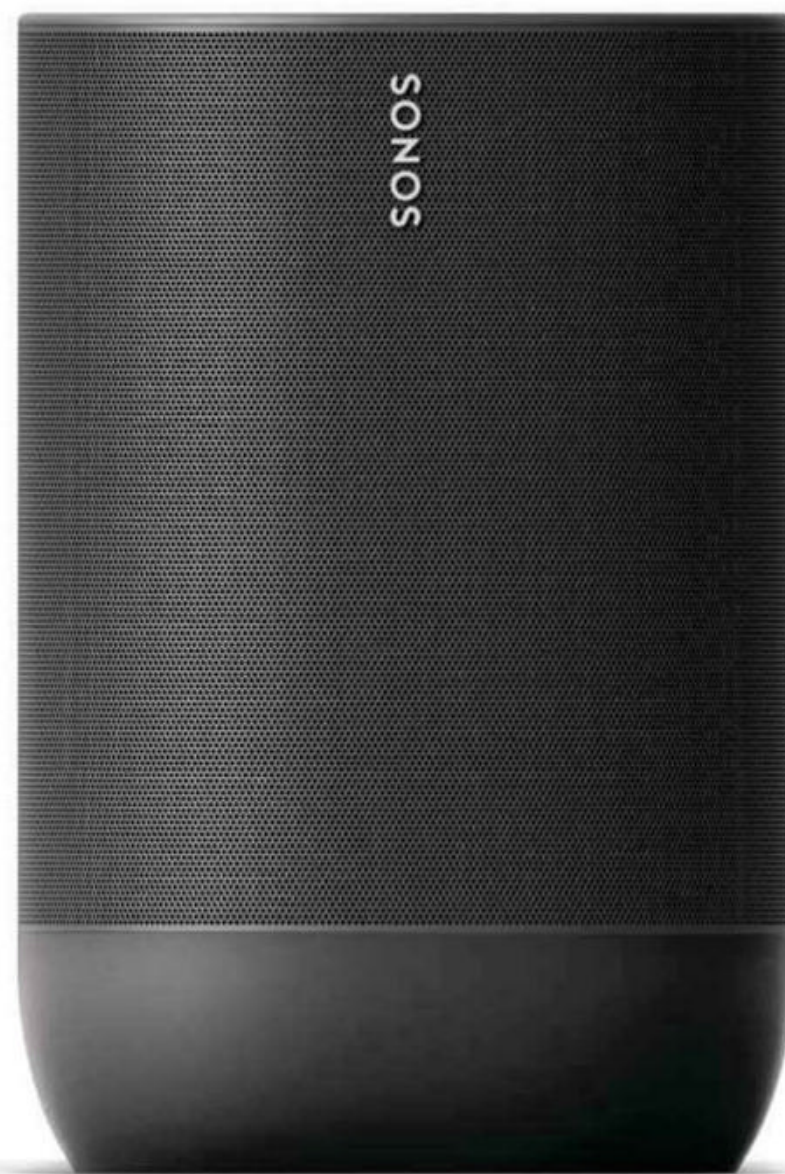
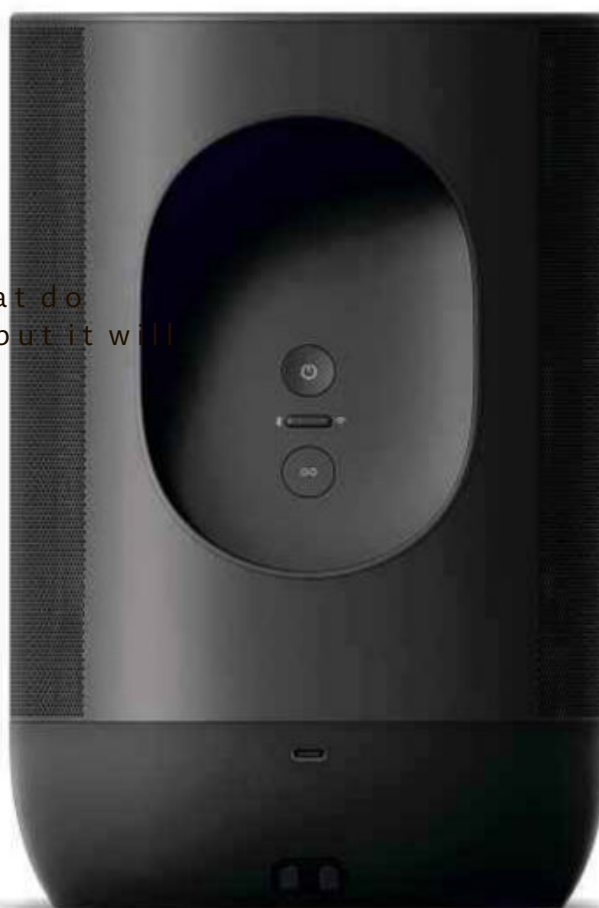
Elsewhere, the Sonos Move is equipped with the same features we've come to love in the Sonos One: support for both Amazon Alexa and Google Assistant; a fantastically easy-to-use app with fully integrated support for Spotify, Tidal, Qobuz and more than 100 other streaming services; and the ability to pair two Sonos Moves together to produce stereo sound.

It's worth noting, however, that you can't use both Alexa and Google Assistant interchangeably, which is a shame. Instead, you have to switch between them in the app. And, in keeping with other third-party smart speaker manufacturers, the Move can't make use of some key Alexa features, such as the useful Drop-in and phone call features.

That's mildly frustrating, but the Move does have the major advantage over Amazon and Google's own smart speakers by being able to form part of a Sonos multiroom network. If you already own a network of Sonos speakers – perhaps a Sonos One in the kitchen and bedroom and a Sonos Beam in the living room – just press the Join button on one of your already connected Sonos speakers, then the Join button on the Move, and they're all linked together.

## DROP OUT

The Move also supports Trueplay, which tunes the speaker's frequency response to suit the room you're in. On previous Sonos speakers, this required a somewhat tedious setup process, but the Move does it all automatically by using its own microphones



to test how the sound bounces around the environment. It works beautifully, except in Bluetooth mode, where Trueplay is disabled.

There's nothing fancy about the driver arrangement inside the Sonos Move. A single, downwards-firing tweeter sits at the top of the speaker, sending high-frequency audio down against a 'waveguide' that then disperses the sound outwards and upwards. Mid and bass tones are handled by a larger, forward-facing mid-woofer, and both drivers are coupled with a pair of digital amplifiers.

The results sound great, and with Trueplay engaged the Move becomes the best-sounding smart speaker on the market. We've used it indoors and outdoors, next to walls and on the floor, placed on shelves and sat in corners, and the Sonos Move consistently punches out audio in a controlled, considered and detailed manner, with high volume potential and plenty of strong, impactful bass.

## INTELLIGENT DESIGN

In short, the Sonos Move is an excellent smart speaker. We were initially surprised at how big and heavy it was: it's certainly not something that can be easily carried around on foot. Still, if you want fantastic sound quality without spending big on the likes of the Naim Mu-so Qb 2nd Generation, you're going to have to accept some compromises, and the Move's battery power still grants it flexibility in where you can listen to it.

At the same time, it's making some steps forward for Sonos as a whole. Besides filling a gap in its multiroom family, automatic Trueplay tuning makes for a significant improvement, one we're hoping to see as standard on future speakers.



SPEAKERS



Award	BEST BUY		RECOMMENDED		
Manufacturer	AMAZON	B&O	BLUESOUND	DENON	
Model	Echo Dot with Clock	Beosound A1 (2nd Gen)	Pulse Flex 2i	Home 250	
Rating	★★★★★	★★★★☆	★★★★☆	★★★★☆	
HARDWARE					
Drivers	1	2	2	4	
RMS power output	Not stated	60W	25W	Not stated	
Audio inputs	None	1x USB Type-C	1x USB2, 1x 3.5mm	1x USB2, 1x 3.5mm	
Audio outputs	1x 3.5mm	None	1x 3.5mm	None	
Dock connector	None	None	None	None	
Networking	802.11ac Wi-Fi	None	802.11ac Wi-Fi, Ethernet	802.11ac Wi-Fi, Ethernet	
Bluetooth	4.2	5.1	4.1	4.2	
NFC	No	No	No	No	
Digital assistant(s)	Amazon Alexa	None	Amazon Alexa, Google Assistant	None (update adding Amazon Alexa and Google Assistant due in 2020)	
Mobile support	Android, iOS	Android, iOS	Android, iOS	Android, iOS	
Power delivery	Mains	Battery	Mains	Mains	
Dimensions	43x99x99mm	46x133x133mm	183x125x100mm	295x216x120mm	
Weight	300g	558g	1.23kg	3.7kg	
Water/dust protection	None	IP67	None	None	
BUYING INFORMATION					
Price	£35	£199	£299	£399	
Warranty	One year RTB	Three years RTB	One year RTB	Two years RTB	
Supplier	www.amazon.co.uk	www.amazon.co.uk	www.amazon.co.uk	www.amazon.co.uk	
Details	www.amazon.co.uk	www.bang-olufsen.com	www.bluesound.com	www.denon.com	
Part code	Echo Dot with Clock	1734001	Pulse Flex 2i BLK	DenonHome 250BKE2GB	

Prices correct at time of going to press

VERDICT

There are no stinkers here, thankfully – although the Denon Home 250 is something of a disappointment, still lacking its promised features well after launch.

Conversely, the Amazon Echo Dot with Clock is a fantastic budget option that’s just as impressive now as it was several months ago. While it only has one internal driver – often a warning sign for audio quality – it sounds much better than you’d think,

and its built-in display adds even more versatility on top of its Alexa smart functionality.

At the opposite end of the price scale is the Naim Mu-so Qb 2nd Generation, a thoroughly modern-looking wired speaker that just about has it all from an audio fan’s perspective: great sound, varied connectivity (including an S/PDIF input), and enough power to fill a room and then some.





		RECOMMENDED		BEST BUY	BEST BUY
	GOOGLE	HARMAN KARDON	JBL	NAIM	SONOS
	Home Max	Citation One MKII	Boombox 2	Mu-so Qb 2nd Generation	Move
	★★★★☆	★★★★☆	★★★★☆	★★★★★	★★★★★
	4	2	2	5	2
	Not stated	40W	80W (mains), 60W (battery)	300W	Not stated
	1x 3.5mm	None	1x 3.5mm	1x USB2, 1x 3.5mm, 1x S/PDIF	None
	None	None	None	None	None
	None	None	None	None	Charging base
	802.11ac Wi-Fi	802.11ac Wi-Fi	None	802.11ac Wi-Fi, Ethernet	802.11n Wi-Fi
	4.2	4.2	5.1	4.2	4.2
	No	No	No	No	No
	Google Assistant	Google Assistant	None	None	Amazon Alexa, Google Assistant
	Android, iOS	Android, iOS	Android, iOS	Android, iOS	Android, iOS
	Mains	Mains	Mains or battery	Mains	Battery
	190x336x154mm	188x140x140mm	257x485x201mm	210x218x212mm	240x160x126mm
	5.3kg	2kg	5.6kg	5.6kg	3kg
	None	None	IPX7	None	IP56
	£199	£180	£400	£749	£399
	One year RTB	One year RTB	One year RTB	Two years RTB	One year RTB
	store.google.com	www.harmankardon.co.uk	uk.jbl.com	www.johnlewis.com	www.currys.co.uk
	store.google.com	www.harmankardon.co.uk	uk.jbl.com	www.naimaudio.com	www.sonos.com
	Home Max	HKCitaOneMKIIGRYEU	JBLBoombox2BLKEU	Muso2Qb	Move1UK1BLK

However, Naim’s speaker will probably prove too expensive for mainstream tastes, so it’s lucky that the Sonos Move costs several hundred pounds less.

This, too, sounds magnificent, and besides joining a long line of Sonos multiroom products, it stands out with its rarely seen combination of battery power and smart speaker features. True, at 3kg the Move needs to be lugged around rather than carried,

but for taking Alexa or the Google Assistant mobile, we can’t think of any better speaker.

Honorable mentions also go to the deceptively powerful Bluesound Pulse Flex 2i and the Harman Kardon Citation One MKII. The latter is relatively lacking in physical connectivity, but it’s Wi-Fi-enabled, sounds good, works in a multiroom setup and is less than half the price of the Sonos Move. 📺





# MOBILE MEMORY

## External SSDs

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Smaller, tougher and faster than hard disks, SSDs make for ideal external drives. In this guide we'll help you find a portable SSD that will leave any mechanical drive in the dust

**IT'S LONG BEEN** true that a solid-state drive (SSD) should form the basis of your PC storage. They're more expensive than hard disks, sure, but even the cheapest SSDs will handily outperform the very fastest mechanical drives, and higher-capacity models are becoming both more plentiful and more affordable.

What's more, although SSDs make for good desktop storage, their inherent qualities make them even better as external storage. They're smaller and lighter than hard disks, so the finished drive will be easier to carry around. Their lack of moving parts makes

them more resistant to knocks and shocks, reducing the chances that the drive – and therefore your data – will be damaged in transit. And, thanks to their higher read and write speeds, they can save huge amounts of time when making big transfers, such as when backing up or restoring your PC or laptop, two of the most common uses for external storage.

Over the following pages we'll walk you through the features and other potential benefits of external SSDs, then take a look at six different models, ranging from simple budget SSDs to PIN-protected drives and



high-speed premium drives. Chances are you'll find something here to replace that sluggish old portable hard disk drive.

### COMING THROUGH

One of the most important, yet often overlooked, factors in an external SSD's performance is its USB interface. Different interfaces have different maximum throughputs, which in turn limits transfer speeds. The basic USB3 standard has 5Gbit/s of throughput, which translates to about 625MB/s, but USB3.1 doubles this to 10Gbit/s, and Thunderbolt 3 connections can reach as high as 40Gbit/s, or 5,000MB/s.

In reality, you're unlikely to come near these theoretical maximum speeds, but our testing shows that faster USB standards do allow for faster read and write speeds. Is the answer, then, to simply stick with Thunderbolt 3 or the recent USB3.2 2x2 interfaces? Sadly, it's not that simple: faster interfaces also mean higher prices, so USB3 and USB3.1 models might still be preferable if you're on a tight budget.

You'll also need to make sure that you can actually take full advantage of more advanced interfaces – in other words, that your PC or laptop has compatible ports. There's little sense in paying more for a Thunderbolt 3 SSD if, say, your laptop only has USB3 ports.

Then again, all the different interfaces are backwards-compatible, so you'll still be able to transfer files if you're plugging a USB3.1 SSD into a USB3 port, or if the SSD is Thunderbolt 3-compatible but is only connected to a standard USB Type-C socket. Just be warned that you won't be getting the best possible performance.

### SPEED LIMIT

On that note, most storage manufacturers will give you an idea of an SSD's top speeds by quoting them among the specs. These are close to reality more often than not, though they're practically always based on the SSD's sequential read/write speeds, which don't strictly represent performance levels in standard usage. For more on this, see 'How we test SSDs' (right).

Naturally we've tested all six of the included SSDs for their actual performance in different conditions, though you may be wondering what is an appropriate level of speed; for infrequent usage, say, you might be willing to settle for slower read and write speeds in exchange for a lower price.

If that's the case, we'd still suggest aiming for speeds between 200MB/s and 500MB/s (the former for the most demanding read/write tasks, the latter for easier ones), just to ensure you're getting a sufficiently sizable bump on hard disk speeds. And, depending on what exactly you're going to be using your SSD for, it's probably worth aiming even higher: if you're just transferring Word files and spreadsheets between two computers this likely won't be the case, but for backing up hundreds of photos or installing large

## One of the most important, yet often overlooked, factors in an external SSD's performance is its USB interface

applications such as games, go for the highest read and write speeds you can afford.

If you just want an external drive to keep whole OS backups in case of PC failure, you potentially won't be using it enough to make the investment in a particularly speedy SSD worthwhile, but remember that as you'll be copying huge amounts of data at a time, you shouldn't go too slow, either.

### A HEAD FOR BYTES

One disadvantage of SSDs next to hard disks is that higher-capacity models of the latter are typically more spacious, and certainly more affordable. Still, it's not hard to find 1TB or 2TB external SSDs, both of which you'd struggle to fill up unless you were absolutely hammering them with video, RAW image or game files.

Smaller capacities are fine if you just want to keep copies of office software files and a handful of media files, and they'll obviously be cheaper, too. However, cheaper doesn't always mean better value: in terms of cost-per-gigabyte, you often get more capacity for your money with larger capacities. We've calculated the cost-per-gigabyte of every available model for the six SSDs featured here,

so consult the table on page 86 to see which capacity of a given drive offers the best deal.

### TOUGH LUCK

SSDs may be harder to break than mechanical HDDs but for external drives, they should still be enclosed in a quality casing to prevent impact damage. Fortunately, most models are built to be at the very least shock-resistant, and some even come with water- and dust-proofing for even greater durability.

Weatherproofing arguably isn't as important as shock resistance for an external SSD, though these days there are portable drives with all sorts of extra features. The Apricorn Aegis Padlock SSD is a perfect example, as it takes the concept of built-in encryption further by including a PIN pad on the chassis, so only you can access the data without using keylogger-susceptible software passwords. The Minix Neo Storage also takes the unique approach of being both an external SSD and a multiport hub.

In both cases, however, the results are both expensive and relatively slow when it comes to core read/write performance, so sometimes the simple approach is better.

## How we test SSDs

We run a battery of different tests on the SSDs that pass through our labs. The first two come courtesy of CrystalDiskMark, which you can download and try for yourself ([crystalmark.info](http://crystalmark.info)).

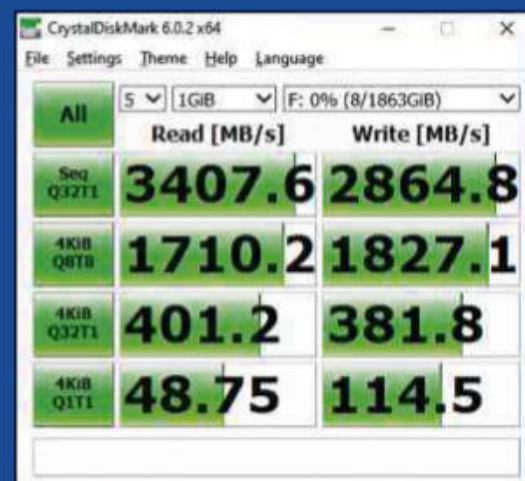
The first test measures the sequential read and write speeds of the drive, meaning how quickly it can operate when dealing with bytes of data that are stored in sequence – when playing a video file, for example, or writing a newly downloaded file as the bytes come in. This is relatively easy work for the drive, so it's very common for SSDs to meet and sometimes slightly exceed their officially stated speeds in this test.

We also use CrystalDiskMark's 4K random test, in which data is accessed non-sequentially in blocks of 4KB. This simulates the task of reading and writing data across various parts of the drive, which takes considerably longer than when the data is neatly stored in order. This is a more realistic indicator of SSD performance, as sequential access to data only occurs very rarely in everyday use.

That said, the 4K random test is still a synthetic benchmark, so for even greater authenticity we employ a set of our own tests that perform actual file transfers within Windows. After reading or writing files of varying sizes and quantities, Nodesoft's DiskBench software ([www.nodesoft.com/diskbench](http://www.nodesoft.com/diskbench)) records the time taken for each transfer in megabytes per second (MB/s).

The huge file test, for example, comprises a single but very long movie file, while the large files test consists of several music tracks. The small files test largely involves shifting dozens of image files.

All three of these tests give us a better idea of how an SSD will cope with jobs of different sizes: the huge file test is the easiest as it only requires moving a single file, even if it is, indeed, huge, while the small files test invariably takes the longest owing to the strain of reading or writing lots of little chunks of data in one go.



↑ Try out the CrystalDiskMark test yourself



## ADATA SD600Q

£54 • From [www.alternate.co.uk](http://www.alternate.co.uk)

## VERDICT

The odd performance wobble isn't enough to spoil this cheap and colourful SSD

**AS USEFUL AS** external SSDs can be, genuinely interesting examples are few and far between. There are a few standouts, such as the blisteringly fast Samsung Portable SSD X5 or the encrypted and PIN-protected Apricorn Aegis Padlock SSD, but both of these come with high prices to go with their high aspirations.

In short, there's room for something that's a little different, while also costing less – and the Adata SD600Q might well be it. With an eye-catching design and overdraft-dodging pricing, it's got charm to spare, and that's not something anyone can say about most storage hardware.

## JARGON BUSTED

It's not exactly packing bleeding-edge tech, however. Adata rather sneakily claims – on its website, the packaging and the documentation – that the SD600Q uses a USB3.1 connection. This is true in a sense, but it's only USB3.1 Gen 1, or USB3 by another name. This has a lower 5Gbit/s throughput than 'true' USB3.1, also known as USB3.1 Gen 2, which can hit 10Gbit/s.

While this means you can plug the SD600Q into USB3 ports – which are far more common on PCs and laptops – without any sense that you're holding back performance, it also means you shouldn't expect that performance to be particularly blazing in the first place. Adata itself claims some merely decent maximum read and write speeds of 440MB/s and 430MB/s respectively, about on a par with a budget internal SATA SSD.

Still, it's cheap enough that lower speeds aren't a turn-off in themselves. We've been testing the 480GB version, which works out at a very attractive 12.1p per gigabyte. There's also a 240GB model, which is 13.9p per gigabyte, and a 960GB model, which is the best value of the bunch at just 10.4p per gigabyte. Compare and contrast with the next-cheapest SSD covered here, the PNY Pro Elite, which ranges between 16.3p for its 1TB model and 25.4p for the 250GB version.

The SD600Q is well put together too, even with some slightly flimsy plastic. This is largely down to the patterned, textured silicone that extends in an X shape to all four corners. As this is raised slightly over the plastic bits, it's almost impossible for the latter to come into contact with surfaces. That, and the rubbery softness of the silicone, grants the SD600Q a limited degree of shock-proofing. Adata has apparently drop-tested it from 1.2 metres, and we didn't suffer any problems after dropping it from similar heights.



The silicone can also optionally add a dash of colour: blue or red on the two smaller capacities, though the 960GB model only comes in black. All three, however, are cutely compact at 15x80x80mm, and with an airy weight of 60g, the SD600Q is well and truly pocket-sized. You'll just have to find room for the 33cm-long detachable USB cable as well.

## FILE AWAY

Performance testing with CrystalDiskMark initially yielded some disappointing results: the standard sequential test typically sees storage drives hit their highest quoted speeds, but the SD600Q only managed a read speed of 303MB/s and a write speed of 398MB/s. The 4K random test was punishing, too, with

its official speed estimates by averaging 544MB/s. It's highly unusual for a drive to perform better in our Windows transfer tests than in the synthetic CrystalDiskMark, but repeated testing showed this wasn't a fluke. Even so, the Pro Elite comfortably beat this effort with 655MB/s.

The rest of our tests showed the same thing: the SD600Q is quick for the money, while not quite competing with great mid-rangers. The SD600Q's huge file read speed may be brilliant, but its 314MB/s write speed is much more down to earth, and its showing in the large files test was middling, too. Its 389MB/s read speed and 300MB/s write speed are further proof that the

## With an eye-catching design and overdraft-dodging pricing, it's got charm to spare

the SD600Q averaging a 98MB/s read speed and a 92MB/s write speed. However, not only are these relatively better than the sequential results, they also come in a little higher than the Pro Elite's respective 79MB/s and 68MB/s read and write speed results.

Otherwise, however, the Pro Elite's faster USB3.1 interface allowed it to consistently outpace the SD600Q. In our huge file read test, the SD600Q actually crashed through

SD600Q is significantly better at one type of workload than the other.

A 239MB/s read speed result in the small files test is pretty good, although yet again, write speeds couldn't match it, coming in at 192MB/s. That's getting close to mechanical hard disk territory, so if you're likely to be dealing with lots of little files at once (as the small file test entails), be prepared.

## SAVER MENU

On balance, the Pro Elite is a better-value SSD even if it's more expensive. Paying a few extra pounds shouldn't be too offputting when you're getting both slightly higher capacity and speeds that easily outdo the SD600Q except in very specific circumstances, and it's not like PNY's drive is anywhere near as costly as the Samsung X5 or the WD Black P50 Game Drive.

Nevertheless, the SD600Q still has plenty of appeal. It exceeds expectations for a relatively budget-friendly external SSD, offers decent shockproofing, and is more colourful and fun-looking than the majority of its peers. There may be quicker SSDs, but the SD600Q is a capable – and interesting – alternative.





## APRICORN Aegis Padlock SSD



£463 • From [www.apricorn.com](http://www.apricorn.com)

### VERDICT

As tough and secure as this PIN-protected SSD is, it's just too expensive

**THE AEGIS PADLOCK** is the solid-state cousin of Apricorn's Aegis Fortress L3 (Shopper 390). It's also an encrypted, PIN-protected external drive for your most sensitive files, but being an SSD rather than a mechanical hard disk, it's smaller, faster and even more expensive.

Much more expensive, in fact: a 1TB Aegis Fortress L3 is no bargain at £215, or 21.5p per gigabyte, but a 1TB Aegis Padlock – like the one we were sent for testing – is a bank-bothering £463, or 46.3p per gigabyte. There are a few other capacity options, but only the 2TB model – which, of course, has a greater outlay – works out with a lower per-gigabyte cost of 40p. The base 240GB model is an outrageous 70.5p per gigabyte, and the 480GB's 56.1p figure isn't much better.

Even the Thunderbolt 3-powered Samsung Portable SSD X5 isn't as expensive, and nor is the Minix Neo Storage, which also throws in USB hub functionality. What, then, do you get for your gigantic pile of money? Some aspects of the Aegis Padlock are oddly basic – it only connects over a USB3 connection, for instance, not USB3.1 or USB Type-C, though the integrated cable does at least tuck neatly into the casing. The included carry pouch is a decent extra, too, though hardly worth an extra couple of hundred pounds.

### HARD HEADED

Instead, the Aegis Padlock attempts to justify its worth entirely through its security and ruggedness. A 12-button keypad enables the creation and use of both admin and individual user PINs, and any data saved is automatically protected behind military-grade, 256-bit AES XTS encryption.

Setting it all up is simple enough, and the keypad buttons are sufficiently big for you to avoid accidental mis-presses even if you've got big thumbs. There's also brute force protection: you can choose how many times, between four and 20, an incorrect PIN is entered, and if that limit is exceeded then the SSD deletes its own encryption key and renders the data onboard inaccessible. This means that if the drive is stolen and the thief activates this self-destruct feature, you won't get the data back even if you somehow retrieve the drive itself, but perhaps that's better than giving someone unlimited chances to guess the code.

The Aegis Padlock is also tough to crack in a more literal sense. The majority of the casing – which is smaller than a pack of cards – is constructed from very sturdy-feeling metal, and the membrane keypad design



allows for both dust- and water-resistance. In fact, it's been granted the IP56 certification, so while it won't survive sustained dunks in water, it will shrug off rain, splashes and spillages, and has sufficient protection from solid dirt ingress to prevent dust or sand from harming the internals. This is, notably, the only SSD of the six on test to offer any kind of certified weatherproofing, which may well appeal if you need one to take far afield.

### MIGHTY GLACIER

Security and durability are also both great qualities to have in any portable SSD, but as with most auto-encrypting drives, the practical trade-off is speed. The Aegis Padlock could only be considered fast if you're comparing it to a hard disk, not another SSD; the fastest we saw it running during our benchmarks was in the CrystalDiskMark sequential read and write tests, where it only managed 301MB/s and 310MB/s respectively. These also dropped drastically in the 4K random tests, with the Aegis Padlock

recording a 21MB/s read speed and a 29MB/s write speed. Both are mere fractions of what the Adata SD600Q, our favourite budget external SSD, scored in the same tests.

Curiously, in our own file transfers tests, the Aegis Padlock switched from having a higher write speed and a lower read speed to the other way around. In the huge file test, it averaged a read speed of 272MB/s and a write speed of 250MB/s, again much slower on both counts than the SD600Q.

It then managed to average slightly faster in the (usually tougher) large files read test, with 295MB/s, although its 244MB/s write speed result brought the combined average down lower than with the huge file test.

To its credit, the Aegis Padlock avoided dropping much lower in the most difficult small files test, ending with a 262MB/s read speed and a 240MB/s write speed. These are actually both higher than the SD600Q's equivalent results, so while peak speeds disappoint, it's reassuring to see the Aegis Padlock can stand up to trickier tasks involving hundreds of tiny files.

### QUESTIONABLE INVESTMENT

Sadly, neither this nor the encryption feature is enough to overcome that prohibitively high price. True, the SD600Q lacks any kind of PIN protection, but the much more similar iStorage diskAshur2 SSD is about £140 cheaper for a 1TB model. This also has 256-bit encryption and an integrated keypad, so you're only really missing out on dust and water protection, which sounds to us like a more than acceptable trade.

As it stands, the Aegis Padlock's security, pocket-friendly design and IP certification are all appealing traits, but without either lower prices or higher speeds, it's not a terribly compelling proposition.





## MINIX Neo Storage



£90 • From [www.amazon.co.uk](https://www.amazon.co.uk)

### VERDICT

As an SSD alone, it's slow and far too expensive, but the Neo Storage's built-in ports make it one of a kind

**THINK OF TWO** accessories you'd want for a laptop and – admittedly after a case and a mouse – two that would probably pop into your head are a USB hub and an external storage drive.

The former is becoming increasingly necessary, as ultraportables continue to ditch full-size USB connectivity in favour of smaller USB Type-C ports that can help keep chassis dimensions slim. External storage also remains a cost-effective tool for ensuring you have adequate space, as upgrading from a 256GB laptop to a 512GB model can add hundreds of pounds to the price.

### PLUG ADDICT

Combining the two is therefore a rather brilliant idea, the kind that makes you wonder why nobody thought of it before the Minix Neo Storage showed up. This multiport hub connects via USB Type-C and provides two USB3 ports, an HDMI output capable of 4K resolution at 30Hz, and a Type-C port of its own, though this is only for connecting the laptop's charging cable so you can refuel while the hub is in use. You can't use it to connect or charge an external Type-C device. All the while, it contains your choice of a 120GB, 240GB or 480GB M.2 SSD, to use just as you would any other external SSD.

The Neo Storage is "designed exclusively" for Apple's MacBook and MacBook Pro laptops, and it shows. The rounded corners and grey, matt aluminium finish clearly evoke more recent MacBook designs, and the Type-C connector is a perfect fit: the MacBook is notoriously devoid of full-size USB ports, relying entirely on Thunderbolt 3 connectors instead.

You can, however, still use the Neo Storage with a Windows PC or laptop, although functionality will vary depending on what kind of Type-C port you're using. A standard Type-C port will, as we've discovered, let you use both USB3 ports and the internal SSD as normal, but the HDMI port becomes useless if the port can't carry video. A full-fat Thunderbolt 3 port is more ideal, as video support is guaranteed.

That the Neo Storage is only at its best with Thunderbolt 3 makes sense given its inclusion of a video port, though as a storage device, this brings it into the orbit of more exclusively Thunderbolt-focused drives such as the Samsung Portable SSD X5. This makes for somewhat awkward comparisons, as Minix itself only claims maximum read and

write speeds of 400MB/s on the 240GB and 480GB models, dropping to 350MB/s read and write on the 120GB model. All of these figures represent a fraction of what the X5 can do, even on its slowest 500GB spec.

In fairness, the 240GB Neo Storage did come decently close its advertised write speed, hitting 373MB/s in the CrystalDiskMark sequential test. Its read

finally caught up with budget SSD standards, averaging a 224MB/s read speed and a 152MB/s write speed. These results are, again, nothing special, but they are comparable with the Adata SD600Q.

Sadly, this also raises a new problem: the SD600Q's mediocre speeds are forgivable because it's so cheap, starting at £33 for a 240GB model; the equivalent Neo Storage

Combining a USB hub and an external storage drive is a rather brilliant idea, the kind that makes you wonder why nobody thought of it before

speed result, on the other hand, was a very modest 300MB/s, and switching to the more demanding 4K test saw the SSD drop down to a 103MB/s read speed and a 100MB/s write speed.

### TURN IT AROUND

Interestingly, read and write speeds swapped around in our own file transfer tests, with read taking the lead. Starting with the huge file test, the Neo Storage average a read speed of 343MB/s and a write speed of 277MB/s – faster than any mechanical hard disk, but not terribly rapid for an SSD.

At least the tougher large files test caused only a slight fall in pace, with an average read speed of 333MB/s and a write speed of 266MB/s. Even so, it wasn't until the small files test that the Neo Storage

is nearly twice as expensive. The 120GB model also works out to an incredibly steep 58p per gigabyte, and although the 240GB model is better at 37.5p, it's not until the 480GB model – at 21p per gigabyte – where prices start sounding reasonable. Yes, it has Type-C connectivity and USB hub capability, but you could buy a separate Mac-friendly hub along with the SD600Q and still save about £40.

### COMBINED POWER

That said, the entire point of the Neo Storage is to combine the two, saving you the trouble of having to carry around multiple accessories along with your laptop – or even just saving clutter on your desktop. Type-C port pickiness aside, this means it has value outside of its core SSD performance. It's well made too, being light, stylish and slim all at once, and there's a nice carry-case included in the box.

We can't recommend it on monetary grounds, nor performance grounds, and if you're more concerned with adding connectivity than storage, you could spend a lot less on something with a lot more than two USB3 ports. With all that in mind, however, this is a unique storage product, and even if it is on the slow side, it doesn't entirely spoil the convenience of its 2-in-1 concept.





## PNY Pro Elite



£163 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

As long as you've got a USB3.1 port handy, the Pro Elite can reach blazing speeds – most of the time

**THE HIGHER SPEED** benefits of choosing an external SSD over an external hard disk are obvious, but don't forget that solid-state drives can be a lot more compact as well. The PNY Pro Elite is a perfect example of how pocket-friendly solid-state storage can be: it's barely thicker than the average smartphone, and is even less wide than a credit card.

This drive is a faster, higher-capacity relative of the PNY Elite, and it proudly derives its speeds from the USB3.1 interface. USB2 and USB3 are both backwards-compatible, but throughput will be more limited. It's not a full-on Thunderbolt 3 SSD, but that's fine, as standard USB3.1 ports are more common on PCs and laptops. You have a choice of how to connect, too, as both full-size Type-A and smaller, reversible Type-C cables are included.

### RUNNING THE NUMBERS

In any case, PNY is making some bold claims about how quickly the Pro Elite can run, albeit with some weirdly varying figures. The middle 500GB model is, according to the company, the slowest, with a maximum read speed of 865MB/s and a maximum write speed of 875MB/s. The 250GB model comes in at 880MB/s for reads and 900MB/s for writes, while the largest 1TB option reads up to 890MB/s and writes up to 880MB/s. This lack of consistency is unusual, to be sure, though all three are inarguably aiming high; for comparison, the USB3.1-based Samsung T5 (Shopper 358) only ever claimed to max out at 540MB/s.

In the first and easiest of our benchmarks, CrystalDiskMark's sequential test, the Pro Elite took a commanding lead over the USB3-based competition, with a 741MB/s read speed and 692MB/s write speed.

There's a bit of bad news in that the Pro Elite doesn't reach its advertised maximums, an otherwise common occurrence in this particular test. Even so, the fact that its top speeds are so much higher than the likes of the Adata SD600Q or Minix Neo Storage – which was a fast SSD to begin with – is more cause for celebration than concern.

Unfortunately, performance promptly went off a cliff in the 4K random test. Recording a read speed of 79MB/s and a write speed of 69MB/s, the Pro Elite was even less capable than the SD600Q at

maintaining pace in this tougher benchmark. Adata's drive read at 98MB/s and wrote at 92MB/s, which might not translate into a drastically noticeable difference in practice, but is the opposite of what we'd expect given the respective technologies behind these two SSDs.

### RECOVERY POSITION

With CrystalDiskMark providing mixed messages, we switched to our own, more realistic file-transfer tests. It didn't take long for the Pro Elite to redeem itself, averaging an exceptional 655MB/s read speed in the

speed and 391MB/s write speed, but those are decent scores nonetheless.

In the end, then, the Pro Elite showcases the benefits for USB3.1 over USB3, and it also looks good next to the older Samsung T5. This was faster in some individual tests, such as the small files read test, but on average the Pro Elite was considerably better at transferring files than this USB3.1 rival.

In the end, it almost doesn't matter that the Pro Elite doesn't run as quickly as it says on the box. It's still plenty fast, and the only compromise it seems to make in the process is becoming very hot – not that there's any

## The PNY Pro Elite is a perfect example of how pocket-friendly solid-state storage can be

huge file test, and while its write result of 440MB/s was less dramatically excellent, both figures still put PNY's drive comfortably ahead of the SD600Q.

In the large files test, the Pro Elite came out on top again with a 590MB/s read speed and a 424MB/s write speed. The gap between this and the SD600Q closed significantly in the small files test, in which the Pro Elite produced a 266MB/s read

particular reason to fret about touching an external SSD while it's connected. Thermal throttling might help explain its 4K random results, but we wouldn't say there's much evidence of it elsewhere.

### GAME PLAN

It's also well priced. The 250GB model works out at 25.4p per gigabyte, the 500GB model at 21.3p and the 1TB model – the one we tested – at 16.3p. These are all less than what you'd pay for the Samsung T5, and keep the Pro Elite affordable for most potential buyers.

This is also one reason we slightly prefer it to the WD Black P50 Game Drive:

this can go even faster, thanks to its USB3.2 Gen 2 2x2 interface, but besides the fact that most laptops and PCs don't feature fully compatible ports, it's also considerably more expensive than the Pro Elite across all equivalent capacities.

On top of all this, the Pro Elite comes with a free activation code for Acronis's True Image data protection and backup software. Not that it needs freebies to be a good deal: this is a wonderfully quick, extremely portable SSD at a very reasonable price.





## SAMSUNG Portable SSD X5



£344 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

If you can find the cash, the pocket-sized X5 will reward you with record-breaking transfer speeds

**WE ORIGINALLY THOUGHT** of the Portable SSD X5 as a loose successor to the T5, Samsung's brilliant and super-compact USB3.1 SSD. But the X5 is very much its own beast. Equipped with an NVMe storage drive and demanding a Thunderbolt 3 connection to make full use of its speeds, the X5 was practically pioneering when it first launched, and in the absence of a follow-up replacement from Samsung, it's still going strong.

### TOP GUN

The combination of an M.2-style NVMe drive and a 40Gbit/s Thunderbolt 3 interface supposedly enables sequential read speeds of up to 2,800MB/s, as well as sequential write speeds up to 2,300MB/s, so even if the X5 falls short of these estimates in real-life use, it still has plenty of room to breeze past any SATA-based alternative. It stands up well against other, more modern SSDs, too: the WD Black P50 Game Drive puts up a good effort, but can 'only' claim a 2,000MB/s maximum read speed.

## For content creators, the biggest draw is performance, and it's here where the X5 truly begins to acquit itself

Sadly, such speeds come a hefty cost, though not nearly to the extent of its launch pricing. There was a time you'd have to pay in excess of £600 for the X5 capacity option we're testing here, the 1TB model; now, it's £344, or 34.4p per gigabyte. That is admittedly still an awful lot of money, and the £180 500GB model – 36p per gigabyte – and the £608 2TB model – 30.4p per gigabyte – will strain the purse strings as well.

There are some feature additions that help soften the blow, and not just to your finances: the casing, a mix of metal and soft, almost rubbery plastic, has been drop-tested to survive drops up to two metres. It's reassuringly durable as a result – especially compared to any mechanical hard disk with moving parts – though there's no waterproofing. There's also 256-bit encryption built in, so simply set a password and all your saved files are treated to professional-grade protection.

That's fitting, as the X5 definitely has an eye on power users rather than those who might just use an external drive to back

up personal files at home. The premium focus is evident everywhere, from the pricing to the exclusively high capacity options (the T5 wasn't cheap either, but it did have a 250GB option).

### IN A BLINK

Of course, for serious content creators, the biggest draw will always be performance, and it's here where the X5 truly begins to acquit itself. We began testing with CrystalDiskMark, and in the standard sequential test, the X5 produced a read speed of 2,776MB/s and a write speed of 2,125MB/s – better than a lot of internal NVMe SSDs can manage. That

read speed in particular is very close to the advertised maximum, which is typically attained though extremely controlled and favourable conditions.

That said, the basic sequential test is fairly easy-going, and speed dropped considerably in the tougher sequential 4K test: this time, the X5 ended up with a read speed of 379MB/s and a write speed of 350MB/s. That's a big drop, but both results are still a lot better than any other external SSD we've used, including the Black P50 Game Drive.

The same was true in our own file transfer tests. Starting with the easiest, the huge file

test, the X5 averaged a read speed of 1,533MB/s and a write speed of 1,509MB/s, about on a par with a middling NVMe internal SSD. Curiously, the write speed actually increased in the more challenging large files test, up to 1,633MB/s, and the average read speed was still remarkably high at 1,425MB/s.

Only the small files test appeared to give the X5 any trouble, with the final read speed working out at 497MB/s and the write speed at 629MB/s. Yet again, however, compared to what the world has become used to in terms of portable SSDs, these are a revelation: even the T5 only managed a read speed of 333MB/s and a write speed of 288MB/s, the latter being less than half of what this NVMe drive can achieve.

### FIND A MATCH

There is one other drawback, however. You can't use the X5 with any old computer – at least, not unless you're willing to cut down performance. You'll need a Thunderbolt 3-enabled USB Type-C port to actually get these spectacular speeds, and that's something you're only likely to find on recent high-end laptops, motherboards and pre-built PCs. It's yet another sign of the X5 being either a professional product or a luxury one.

A similar issue affects the Black P50 Game Drive, which uses an even less common connection interface. A good USB3.1 or even just USB3 SSD would therefore make more financial sense if your computing device of choice has these more common ports.

Otherwise you're essentially paying for performance that can't be attained without also upgrading your PC or laptop, and no portable SSD is really worth that alone.

Still, the X5 is – by miles – the fastest external SSD we have on record, and affords video editors, 3D modellers and other content creators a level of flexibility in their storage options that previously simply wasn't possible. That's Best Buy material if you ask us.





# WHAT IS AVAXHOME?



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## WD Black P50 Game Drive



★★★★★

£380 • From shop.

westerndigital.com

### VERDICT

It's expensive and uses a rare USB standard, but this hardy SSD's high speeds are worth it

**WITH ALL DUE** respect to the WD Black P10 Game Drive (*Shopper 385*), it was always going to be overshadowed by the Black P50 Game Drive. Being an SSD instead of a hard disk, it's much smaller, lighter and faster, all good qualities to have in an external drive.

While it isn't as truly tiny as the PNY Pro Elite, the Black P50 Game Drive is shorter, narrower and only slightly thicker than most smartphones, so it's perfectly portable. It's tough, too: there's no bending or flexing at all, thanks to the shock-proof metal casing, and a set of four rubber feet help prevent it being accidentally knocked off a table or from causing vibration noises when sat atop a desktop PC.

### STRADDLING LANES

The most interesting thing about this drive, however, requires us to delve into the most confusing aspects of recent USB developments. The Black P50 Game Drive uses a 'USB3.2 Gen 2 2x2' connection, which is distinct from what manufacturers often call USB3.2 – really just USB3.1 – in that it uses two 10Gbit/s lanes instead of just one, as USB3.2/USB3.1 does. It's backwards-compatible, naturally, but you'd be limited by the lower throughputs of the older ports.

The obvious benefit to the 2x2 standard is higher transfer speeds without needing to implement Thunderbolt 3, which – as we've seen from drives such as Samsung's Portable SSD X5 – massively jack up the price. The 2TB X5, for example, is £608, or 30.4p per gigabyte; the Black P50 Game Drive's 2TB model, which we reviewed, works out to 19p per gigabyte. As this is a high-end SSD designed to store entire AAA game installations as well as photos, documents and videos, there are no small capacity options, but the 1TB model works out to a reasonable 22p per gigabyte. Only the 500GB version is questionable, at 26p per gigabyte.

In all three cases, the Black P50 Game Drive is undeniably expensive, and more so than high-performance USB3.1 SSDs such as the Pro Elite and Samsung's older T5. However, it has next-gen tech and is still a lot cheaper than any Thunderbolt 3 rival,

potentially making for an attractive middle ground.

The downside is that because USB3.2 Gen 2 2x2 is still a relatively new technology, fully compatible ports are even rarer than Thunderbolt 3 sockets. Most PC motherboards won't have any, and games console owners are completely out of luck: even the top-spec PS4 Pro only has USB3.1 connectivity, while the Xbox One makes do with USB3. Indeed, we didn't even have access to a suitable port for this review, forcing us to run tests via a USB3.1 connection.

Don't walk away just yet, however. It might seem silly to pay more for technology that you probably can't fully use, but the P50

## Ultimately there wasn't a single test in which using USB3.1 seemed to trouble the Black P50 Game Drive much at all

Game Drive doesn't actually need a 2x2 port to perform well: it's extremely fast over garden-variety USB3.1, too. In the CrystalDiskMark test, we measured a sequential read speed of 1,061MB/s and a sequential write speed of 1,023MB/s.

### PACK LEADER

Yes, on a 2x2 connection it's very likely that the Black P50 Game Drive would be roughly twice as fast, but that also means it's maxing out the much more common and attainable USB3.1 platform, and that's impressive in its own right. The Samsung T5 was only just over half as fast in the same tests, and the Pro Elite's respective results of 741MB/s and 692MB/s are far behind as well.

write speed of 653MB/s, handily beating the Pro Elite on both counts.

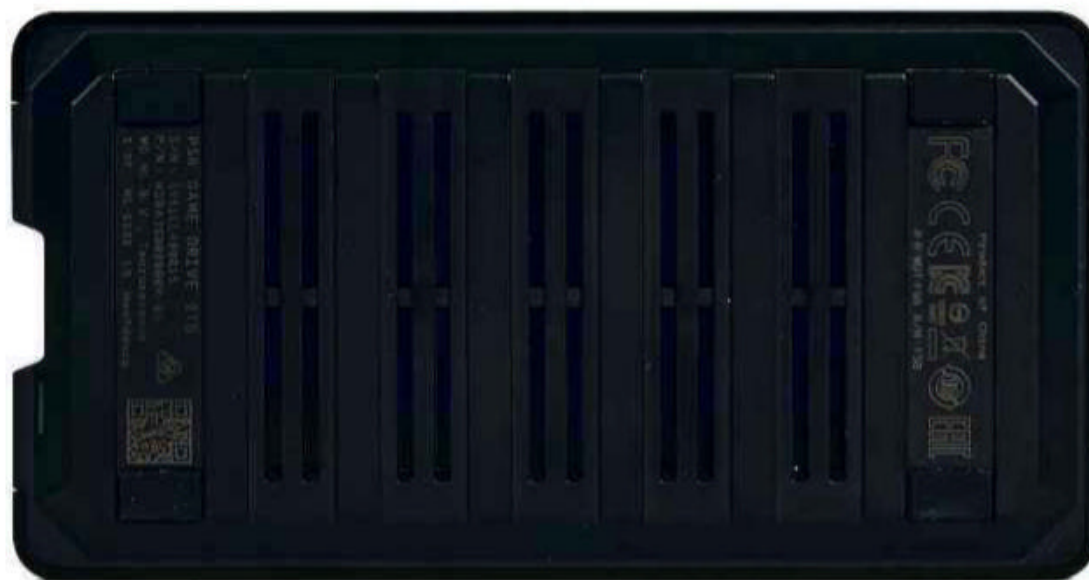
It also barely dropped performance in the harder large files test, producing an average read speed of 649MB/s and a write speed of 621MB/s. The Pro Elite's write speed sits particularly far behind the P50 here, although its 590MB/s read speed is much more competitive.

Lastly, the Black P50 Game Drive managed a 392MB/s read speed and a 461MB/s write speed in the most difficult small files test, winning once again. Ultimately there wasn't a single test in which using USB3.1 seemed to trouble it much at all: the closest the Pro Elite came to beating it was scoring 655MB/s in the huge file read test, but otherwise the

Black P50 Game Drive won by big margins.

### BLACK GOLD

You could say that since it's more expensive, faster speeds should be expected, and that's true – but the Pro Elite was already a great performer for its price. The Black P50 Game Drive is simply a good alternative if you want even higher speeds, but don't quite have the budget to burn on a Thunderbolt 3 SSD.





EXTERNAL SSDs



Award	RECOMMENDED			
Manufacturer	ADATA	APRICORN	MINIX	
Model	SD600Q	Aegis Padlock SSD	Neo Storage	
Rating	★★★★☆	★★★★☆	★★★★☆	
HARDWARE				
Interface	USB3	USB3	USB Type-C	
Capacities	240GB, 480GB, 960GB	240GB, 480GB, 1TB, 2TB	120GB, 240GB, 480GB	
Cost per gigabyte	13.9p (240GB), 11.2p (480GB), 10.4p (960GB)	69.6p (240GB), 49.8p (480GB), 46.3p (1TB), 43p (2TB)	58p (120GB), 37.5p (240GB), 21.9p (480GB)	
Dimensions	15x80x80mm	14x65x84mm	11x115x44mm	
Weight	60g	104g	72g	
Claimed read speed	440MB/s	Not stated	350MB/s (120GB), 400MB/s (240GB and 480GB)	
Claimed write speed	430MB/s	Not stated	350MB/s (120GB), 400MB/s (240GB and 480GB)	
Weatherproofing	None	IP56 dust resistance and waterproofing	None	
Shock-resistant	Yes	Yes	No	
Other features	None	Encryption, integrated PIN pad	2x USB3 ports, 1x USB Type-C port, 1x HDMI output	
BUYING INFORMATION				
Price	£33 (240GB), £54 (480GB), £100 (960GB)	£167 (240GB), £239 (480GB), £463 (1TB), £861 (2TB)	£70 (120GB), £90 (240GB), £105 (480GB)	
Warranty	Three years RTB	Three years RTB	Three years RTB	
Supplier	www.alternate.co.uk	www.apricorn.com	www.amazon.co.uk	
Details	www.adata.com	www.apricorn.com	www.minix.com	
Part code	ASD600Q-240GU31-CBK (240GB), ASD600Q-480GU31-CBK (480GB), ASD600Q-960GU31-CBK (960GB)	ASSD-3PL256-240F (240GB), ASSD-3PL256-480F (480GB), ASSD-3PL256-1TBF (1TB), ASSD-3PL256-2TBF (2TB)	NEO S2	

Prices correct at time of going to press

VERDICT

If you’re mainly concerned with maximising speed, and have both the cash and the appropriate Thunderbolt 3 ports to support it, only one of these SSDs truly pushes the limits of what portable SSDs are capable of: the Samsung Portable SSD X5. Its monster performance and multiple high-capacity models should make it the first port of call for anyone wanting the best of the best.

WD’s Black P50 Game Drive also impresses. It’s unfortunate that the USB3.2 2x2 interface isn’t more widely available, but it still

paces along in read and write tasks on lower-spec ports, and it’s a lot more affordable than the X5, although is still one of the more expensive external SSDs.

We think the PNY Pro Elite offers the better balance of performance, price and portability. Not only is it tiny and lightweight even by SSD standards, but it keeps its pace up well in demanding data transfers, and it’s considerably cheaper than the P50 both in terms of total outlay and cost-per-gigabyte.





BEST BUY	BEST BUY	RECOMMENDED
<b>PNY</b>	<b>SAMSUNG</b>	<b>WD</b>
Pro Elite	Portable SSD X5	Black P50 Game Drive
★★★★★	★★★★★	★★★★★
USB3.1/USB Type-C	USB Type-C (Thunderbolt 3)	USB3.2 Gen 2 2x2
250GB, 500GB, 1TB	500GB, 1TB, 2TB	500GB, 1TB, 2TB
25.4p (250GB), 21.3p (500GB), 16.3p (1TB)	36p (500GB), 34.4p (1TB), 30.4p (2TB)	26p (500GB), 22p (1TB), 19p (2TB)
11x64x57mm	20x119x62mm	14x118x62mm
45g	150g	115g
880MB/s (250GB), 865MB/s (500GB), 890MB/s (1TB)	2,800MB/s	2,000MB/s
900MB/s (250GB), 875MB/s (500GB), 880MB/s (1TB)	2,100MB/s (500GB), 2,300MB/s (1TB and 2TB)	Not stated
None	None	None
Yes	Yes	Yes
Acronis True Image software	Encryption	None
£64 (250GB), £107 (500GB), £163 (1TB)	£180 (500GB), £344 (1TB), £608 (2TB)	£130 (500GB), £220 (1TB), £380 (2TB)
Three years RTB	Three years RTB	Five years RTB
www.amazon.co.uk	www.amazon.co.uk	shop.westerndigital.com
www.pny.eu	www.samsung.com	www.westerndigital.com
PSDOCS2060-250-RB (250GB), PSDOCS2060-500-RB (500GB), PSDOCS2060-1TB-RB (1TB)	MU-PB500B/WW (500GB), MU-PB1T0B/WW (1TB), MU-PB2T0B/WW (2TB)	WDBA3S5000ABK-WESN (500GB), WDBA3S0010BBK-WESN (1TB), WDBA3S0020BBK-WESN (2TB)

Its interchangeable USB3.1/USB Type-C cables also ensure you'll always be able to connect without needing to carry a separate adaptor, which is handy.

The Adata SD600Q is also a great budget buy. It may not be close to the fastest SSD around, but it's a major upgrade on any hard disk, and its colourful design provides some extra shockproofing as well as a fun look. This definitely helps produce the feeling that you're not just getting bargain-bin basics.

As for the Apricorn Aegis Padlock SSD and Minix Neo Storage, both are interesting niche products; the Neo Storage is particularly creative, being both a multiport hub and a storage device in one. However, both stumble on the fundamental quality of speed, so are difficult to recommend when they're both so much more expensive than their more straightforward SSD peers. Unless, that is, the Aegis Padlock SSD's security or the Neo Storage's flexibility will be of genuine use to you. 📺

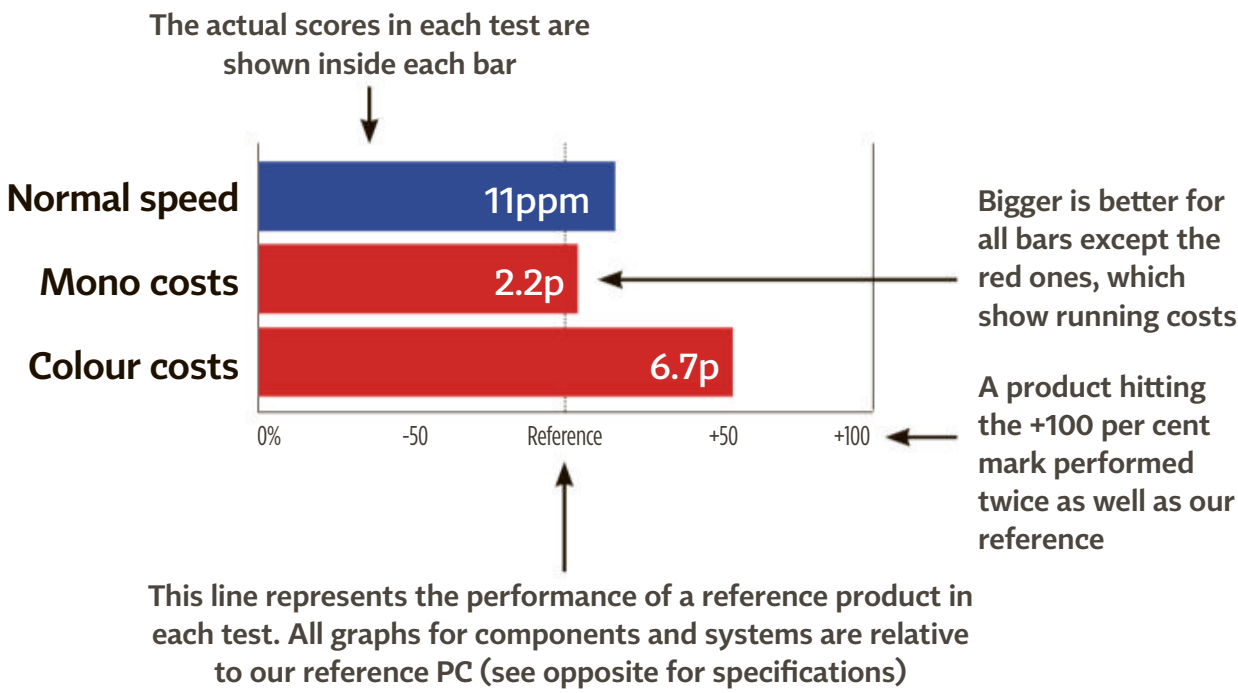


# How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

**COMPUTER SHOPPER'S REVIEWS** use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the *Reviews* section, as shown on the right. Look in the 'Summary of tests' table (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See opposite for a description of our benchmarking software and game tests.



## SUMMARY OF TESTS

PC SYSTEMS & GAMING LAPTOPS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Metro: Last Light Redux (1080p)	Frames per second at 1,920x1,080, SSAA, Very High detail
LAPTOPS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Processor-intensive multitasking test
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
Battery life	Run time in minutes for continuous video playback
SMARTPHONES/TABLETS	
Battery life	Run time in minutes for continuous video playback
PRINTERS AND MFPs	
Mono text speed	Pages per minute for correspondence-quality text
Mixed colour speed	Pages per minute for presentable text and graphics
Mono page cost	Running costs expressed as pence per page
Colour page cost	Running costs expressed as pence per page
DIGITAL CAMERAS	
Battery life	Number of shots from full charge
CAMCORDERS	
Battery life	Run time in minutes for recording
ROUTERS	
Laptop 2.4GHz 5m	Mbit/s at 5m with 802.11ac laptop on 2.4GHz band
Laptop 2.4GHz 1 floor	Mbit/s 1 floor up with 802.11ac laptop on 2.4GHz band
Laptop 2.4GHz 2 floors	Mbit/s 2 floors up with 802.11ac laptop on 2.4GHz band
Laptop 5GHz 5m	Mbit/s at 5m with 802.11ac laptop on 5GHz band
Laptop 5GHz 1 floor	Mbit/s 1 floor up with 802.11ac laptop on 5GHz band
Laptop 5GHz 2 floors	Mbit/s 2 floors up with 802.11ac laptop on 5GHz band
NETWORK-ATTACHED STORAGE	
Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files
HARD DISKS	
Huge files	Average MB/s for read/write of a single 2.5GB file
Large files	Average MB/s for read/write of 2.5GB of large files
Small files	Average MB/s for read/write of 2.5GB of small files
PROCESSORS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
MOTHERBOARDS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
GRAPHICS CARDS	
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4x MSAA, Ultra detail
Tomb Raider	Frames per second at 1,920x1,080, SSAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail



## BENCHMARKS



## SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, macOS and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

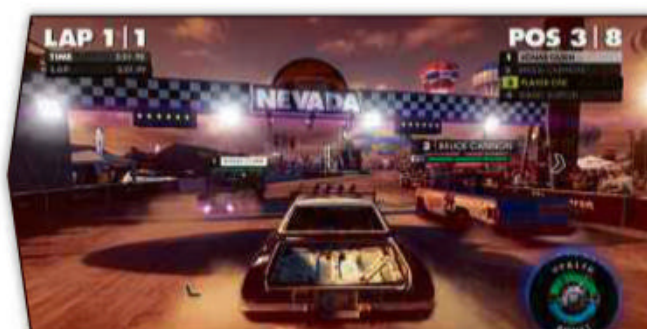
We ran the tests on our reference PC, which has an Intel Core i5-4670K processor, 8GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a hybrid, laptop or desktop, from both sections of the magazine.

## 3D BENCHMARKS

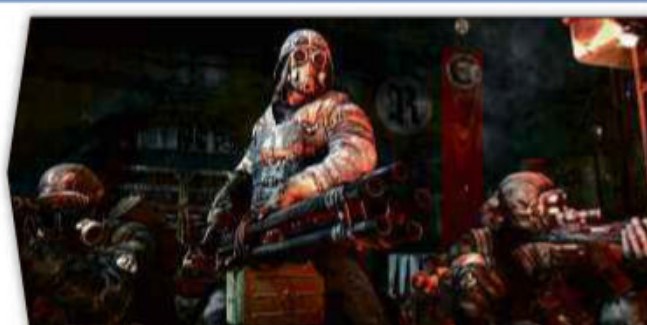
## DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll want at least 30fps for smooth racing.



# TOMB RAIDER

**With the ultra-demanding Super-Sampling Anti-Aliasing (SSAA) enabled, 2013's Tomb Raider reboot is a great indicator of mid-range performance.**



## METRO: LAST LIGHT REDUX

Our most demanding graphics test uses tessellation, SSAA and massive textures to give even high-end cards a thorough workout.

## RATINGS & AWARDS

**Computer Shopper rates products out of five:**



## Excellent



**Very good**



**Good**



**Below average**



**Avoid!**

**The best products can win  
the following awards:**

## BEST BUY

**Products with outstanding quality and performance for the money win our Best Buy award.**

# COMPUTER SHOPPER

## BEST BUY

## RECOMMENDED

Products that don't quite qualify for a Best Buy award but are still highly rated by our reviewers.

## COMPUTER SHOPPER

**BUSINESS BUY**  
The very best products for work  
win our Business Buy award.

# COMPUTER SHOPPER

## BUSINESS BUY



# Product Reviews

Your guide to all the products reviewed in this month's *Computer Shopper*

138  
reviews

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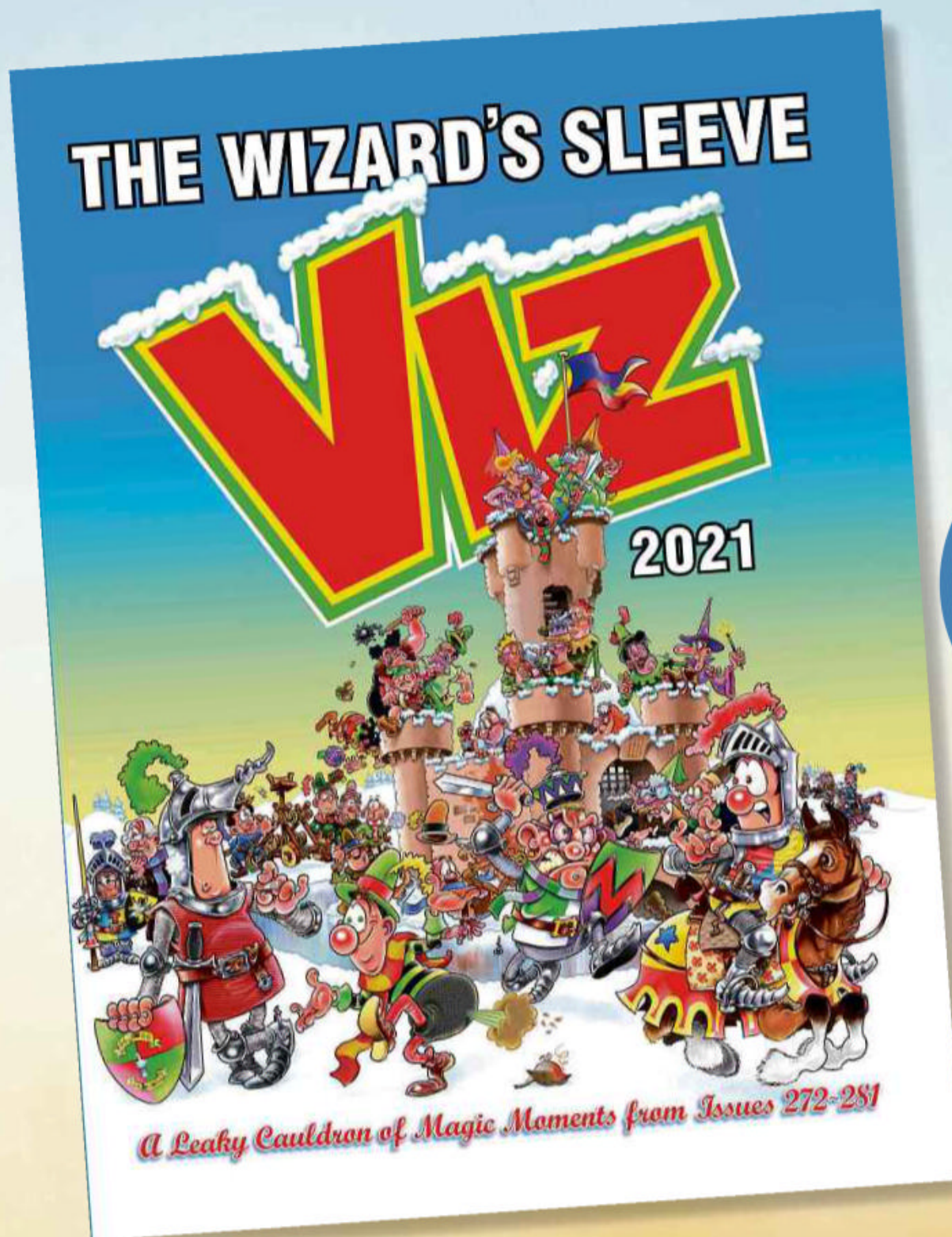


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# VIZ

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\*\*Source: ABC figure experienced during a dream after eating a large amount of cheese





FAILURE





# SOFTWARE

# FAILURE

# THE COST & THE CURE

MIKE BEDFORD UNVEILS THE MASSIVE COST OF SOFTWARE FAILURE – BOTH IN TERMS OF MONEY AND HUMAN LIFE – AND INVESTIGATES THE METHODS USED BY SOFTWARE ENGINEERS TO HELP PREVENT FUTURE INCIDENTS





**F**or the 181 passengers and eight crew members who boarded Lion Air flight 610 from Jakarta, Indonesia, on 29th October 2018, the flight to Depati Amir was expected to last one hour.

Instead, air traffic control lost contact with the aircraft just 13 minutes into the flight. Wreckage was subsequently found 34km off the coast of Java, and the authorities announced that all on board had perished. Less than five months later, Ethiopian Airlines Flight 302 was lost six minutes after take-off, while en route from Addis Ababa in Ethiopia to Nairobi in Kenya, with the loss of all 157 people on board.

These incidents might have taken place on different continents, almost 8,000km apart, but in other respects, the two accidents were remarkably similar: both involved a Boeing 737 MAX series aircraft. Within days, all the world's operational 387 Boeing 737 MAX aircraft – which served 8,600 flights a week, operated by 59 airlines – were grounded. Investigations subsequently discovered that the crashes were due to a malfunction in a software system called the Manoeuvring Characteristics Augmentation System, which makes the nose feel heavy through the control column, so the pilot will not

↑ Hundreds of Boeing 737 MAX aircraft were grounded following two crashes that were caused by a software defect

pull the airplane up too steeply and, in so doing, cause the aircraft to stall.

The 737 MAX might have represented a very costly example of the cost of software defects, but it's just the tip of a very large iceberg, as we're about to see. However, our aim isn't just to paint a grim picture of software failure, but also to offer a glimmer of hope.

According to experts, the huge scale of software errors doesn't have to be accepted as a fact of life. So we'll also look at good practice and research into quality-related aspects of software

engineering and testing, which experts believe will bring us much needed improvements in software quality.

## THE COST OF SOFTWARE FAILURE

The two 737 MAX incidents involved the ultimate cost – that of human life – with no fewer than 346 people paying with their lives. We might not tend to associate software failure with this sort of human misery, but it's a depressing fact that these haven't been the only times that software defects have resulted in the loss of life, and they almost certainly won't be the last. In

fact, our exposé of high-profile software failures on page 97 includes another instance in which life was lost.

More commonly, poorly written software has a financial cost, and here the figures are staggering. The 737 MAX fiasco, for example, reportedly cost Boeing \$20bn, and resulted in the company's first two



◀ Crash test dummies: software failure can have potentially catastrophic effects





quarters of loss in two decades. Some analysts even questioned whether the company would survive. But this pales into insignificance when we take a look at the global cost of software failures.

Headquartered in Vienna, software testing and quality assurance solution provider Tricentis produces the *Software Fail Watch* report. Last published in January 2018, and covering the previous year, the report presents an analysis of some of the highest-profile and costliest software failures to have been publicly reported.

The headline figures are staggering. A total of 606 serious software failures were identified worldwide, impacting half of the world's population – 3.7 billion people – and 314 companies. The overall cost was put at \$1.7 trillion.

And this, they said, is just scratching the surface, as there are far more software defects in the world than we will likely ever know about.

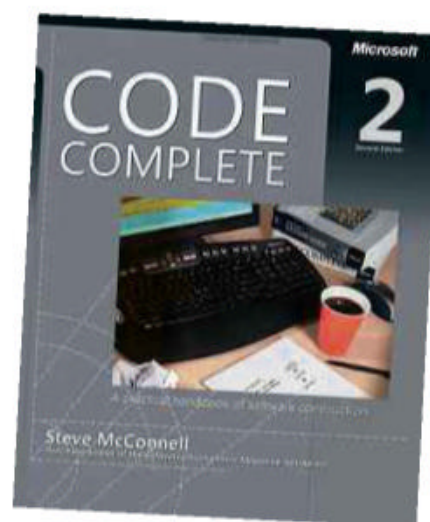
Also in 2018, the Consortium for IT Software Quality produced a report that painted an even gloomier picture. Many of the costs of poor IT software quality, it argues, are hidden and hard to identify. Nevertheless, it estimated that the total cost of software failures was \$2.84 trillion per year for the USA alone, the country accounting for just a quarter of the world economy.

## A TOTAL OF 606 SERIOUS SOFTWARE FAILURES WERE IDENTIFIED WORLDWIDE, IMPACTING HALF OF THE WORLD'S POPULATION

Sums of money like these are pretty much impossible for us to get our heads around, so let's take a look at some more technical measures of software quality. The figures are no less mind blowing. A common industry statistic is the measure of defects per 1,000 lines of code (KLOCs). The classic work on this subject is Steve McConnell's book *Code Complete* and, although the most recent edition was published back in 2004, it gives some useful insight into the subject. He concluded that an industry average is 1-25 errors per KLOC in delivered code, but the differences are huge.

Microsoft, he suggested, finds 10-20 defects per KLOC during in-house testing, but gets this down to 0.5 in production. Emphasising that necessity is the

↓ Steve McConnell's *Code Complete* estimates there are on average 1-25 errors per 1,000 lines of code



mother of invention, he claimed that NASA achieved zero defects for the Space Shuttle software, but at a cost of thousands of dollars per line of code.

More recent studies are few and far between and, let's face it, this isn't exactly an easy figure to come up with. However, a few statistics about the size of some of today's software will allow you to come up with an estimate, admittedly a very rough one, of how many errors are likely to be contained in software you use on a daily basis. It's been suggested, for example, that Android contains 12 million lines of code and, for Windows 10, this increases to 50 million; that's 50,000 KLOCs.

But this pales into insignificance against Google, which apparently uses a 2 billion-line code repository (2 million KLOCs) to drive its various internet services. We can but hope that quality has improved in the 16 years since McConnell came up with his estimates. In fact, as we'll see later, there's a good chance it has.

### GETTING IT RIGHT

In light of the phenomenal cost of software failure, there's undoubtedly a huge impetus to eliminate errors in code. But surely



# NASA ACHIEVED ZERO DEFECTS FOR THE SPACE SHUTTLE SOFTWARE, BUT AT A COST OF THOUSANDS OF DOLLARS PER LINE OF CODE



that's easier said than done, a sentiment that will ring true with anyone who has ever been involved in programming. To get a view of current initiatives and research into software quality, we spoke to Stuart Reid, CTO for South Korean-based STA Consulting. Reid has a PhD in software testing, he has been convener of the ISO/IEC Software Testing Working Group since its inception in 2007, and he is founder of the ISTQB software-testing certification organisation.

In recent decades, there has been a move in industry generally from the old approach of quality control to quality assurance. So, instead of checking products as they come off a production line and discarding those that don't come up to scratch, quality is built into the product by ensuring good practice throughout the whole design and manufacturing process. We wondered whether the same applies to the software industry. Reid says that it most certainly does.

"Recently, the concept of 'shift-left' has been introduced, which encourages quality-based activities, and especially software testing, to be performed as early as possible in the life-cycle," he explains, before describing several key

↑ Google uses a massive 2 billion-line code repository to drive its various internet services

↓ Stuart Reid, founder of the ISTQB software-testing certification organisation



activities that take place early in the design cycle.

Interestingly, however, some of those activities don't really sound like software testing in the normal sense of the word. But, he says, this approach certainly has its benefits.

"It makes the later phases of testing less about defect detection and more about confirmation that the system works as expected," he adds.

However, if you think this means that traditional software testing is a thing of the past, think again.

"Unhappily, software testing still takes up a significant proportion of software development costs," Reid explains.

"Many organisations currently expect to spend about a quarter of their budgets on testing, and the testing on safety-related systems costs far more."

Software engineers often refer to black box and white box testing. We asked Reid to differentiate between the two and give some indication of how important each is. It transpires that the black box approach is what most people associate with software testing.

"With black box testing, we test based on our knowledge of specified requirements, and have no visibility of the source code. So we are testing to see if the delivered item meets the

specified requirements without worrying how it does it. Meeting requirements is very important to the customer, and black box tests are relatively easy to understand from their perspective," he says.

White box testing, on the other hand, is quite different.

"With white box testing we generate tests to exercise specific parts of the system, so we must be able to see the source code," he explains.

"Because white box testing is at the code level, it is normally performed by developers rather than testers. Testing at this detailed level is more expensive, but can find defects that would be very difficult to find otherwise.

"In practice, we always perform black box testing and then, where the perceived risk of failure is high enough, we also perform white box testing to supplement it."

Black box and white box testing might be new terms to those not involved in software engineering, but a term that is commonly bandied around among computer users is beta testing. We'll come to that later, but it raises the question of whether there's such a thing as alpha testing.

Well it appears that there is, and both alpha and beta testing are types of black box testing. Alpha testing is carried out by the software developer and, according to Reid, it poses some major challenges.

"For all non-trivial systems, there are a near-infinite number of possible input combinations that could be chosen as potential test cases – think of all the



# SOFTWARE FAILURES

## HEATHROW

This February saw over 100 flights cancelled at Heathrow as an IT issue affected departure boards and check-in systems, and limited the use of electronic tickets. And this wasn't the only time that software failures have caused havoc at the airport.

Perhaps most famously, at the opening of Terminal 5 in 2008, the baggage-handling system failed, resulting in a backlog of 15,000 items of luggage, the cancellation of dozens of flights, and hundreds of passengers travelling without their luggage.

## NASA

23rd September 1999 is a date that NASA would like to forget, especially since the software defect that caused the loss of its \$327m Mars

Climate Orbiter was nothing other than a schoolboy error. At the time, all that NASA engineers knew was that communication with the probe was lost as it approached the planet. It was later revealed that the software had confused metric and imperial units, causing the

spacecraft to take a trajectory that brought it too close to the planet's surface, with disastrous results.

## NHS

It was widely reported in 2017 that 709,000 items of mail from the NHS were never delivered to patients or their GPs. The lost documents included treatment plans, details of medication changes, child protection notes and test results. A review found 1,788 cases of potential harm to patients. The 2017 Software Fail Watch attributed this to a software glitch.



▲ Hundreds of thousands of NHS letters were lost in 2017 following a software failure



▲ Airports and luggage go together, until, that is, a software glitch ensured that passengers and their baggage didn't go together, quite literally

## 02

Thirty million O2 subscribers were left without data access for 24 hours in January 2018 as the network suffered software issues. And it wasn't just phone users who were affected. Among the other services that use the O2 network, Transport for London's electronic timetable service at bus stops also stopped working.



## EUROPEAN SPACE AGENCY

The European Space Agency is now a major player in propelling payloads into orbit, but the maiden voyage of its Ariane 5 rocket in 1996 wasn't exactly an auspicious start. Just 30 seconds into that flight, Ariane veered abruptly off course. Seconds later, it started to break up and, as a result, the on-board Flight Control System triggered a self-destruct sequence.

That incident has been referred to as one of the most expensive computer bugs in history. And for the coders among you, you might be interested and appalled to learn that this incident was caused by copying a 64-bit floating point variable into a 16-bit integer variable.

## UBER

The death of Elaine Herzberg, who was hit by a car as she was crossing a road in Tempe, Arizona, is particularly worrying. For the vehicle that was involved in the 2018 accident was an Uber self-driving test vehicle, and its onboard software failed to identify Elaine as a pedestrian. An ensuing report by the US National Transportation Safety Board revealed that there had been 37 crashes of Uber vehicles in self-driving mode between September 2016 and March 2018. Authorities subsequently suspended Uber's testing of self-driving cars on Arizona's public roads.



▲ Self-driving cars must be one of the most challenging tasks for software, and also one of the most unforgiving of errors

Photo: Tony Webster.



possible combinations and sequences of words you could ask a word processor to work on. Testers are faced with the challenge of selecting a tiny subset of this huge set because they have a limited amount of time to run the tests and analyse the results. They hope that their choice provides reasonable coverage of the system, finds most of the defects, or achieves some balance of these goals,” he says.

Despite the difficulties, however, trends in software engineering are providing ever better solutions to achieve these goals, and one of these is automated testing – that is, using software to test software, as Reid elaborated.

“If we need tests to be reusable – an attractive characteristic if we need to run tests again after a fix or system update – or we want to automate test execution, then we will need to use a scripted approach in addition to exploratory testing. The long overdue ‘silver bullet’ of full test automation is yet to arrive, with, on average, still less than half of all tests being run by tools after many decades of test automation hype from tool vendors,” he says.

So what about beta testing, and where does that come into the mix?

Reid explains, “Alpha testing, performed by the testers at the development site, will ideally find the majority of defects in a system. However, the effectiveness of this testing is limited by two major constraints. First, the testers are often ignorant of how end users will actually use the software. Second, this testing is limited by the availability of real-world test environments. For instance, the tester of a mobile phone app will not have access to every different type of Android phone, every version of the Android operating system, and every different network type in the world. One solution is to use beta testing, where an early version of the system is provided to end users for them to use in their own environments.”

# SOFTWARE BUGS

The word ‘bug’ is commonly used to refer to defects in software, both in the mainstream media and by programmers. Coders often use the phrase ‘debugging’ to refer to the all-too-familiar process of finding and correcting errors that have resulted in the incorrect operation of a program. You might be interested to learn that, in the early days of computing, the inevitability of correcting software errors wasn’t appreciated.

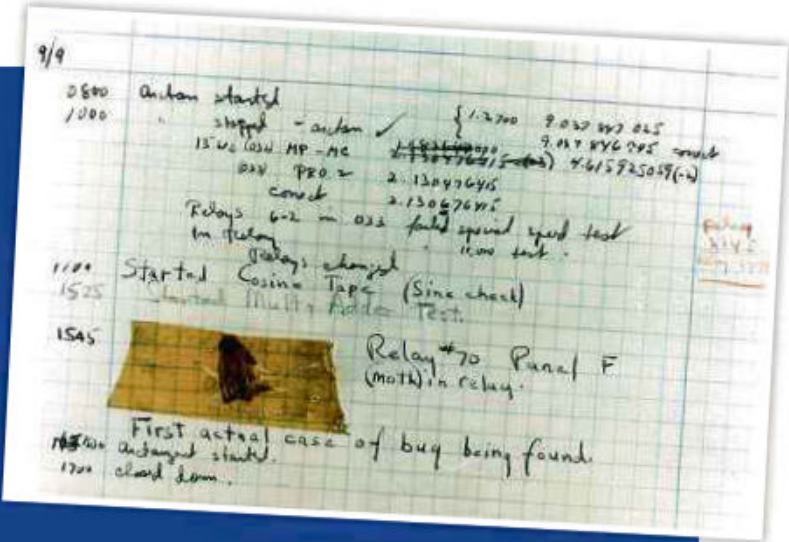
Until, that is, the penny dropped to Maurice Wilkes, one of the masterminds behind the University of Cambridge’s pioneering EDSAC computer, which is generally acknowledged to be the world’s first stored program computer that was put to real-world use.

“By June 1949, people had begun to realise that it was not so easy to get programs right as at one time it appeared,” Wilkes later explained.

“I well remember when this realisation first came on me with full force. The EDSAC was on the top floor of the building, and the tape-punching and editing equipment one floor below... It was on one of my journeys between the EDSAC room and the punching equipment that, hesitating at the angles of stairs, the realisation came over me with full force that a good part of the remainder of my life was going to be spent in finding errors in my own programs.”

You’ll notice that Wilkes never used the word bug; in fact, software quality experts often discourage its use. The reason, apparently, is that having a bug in your software doesn’t sound as damning on the programmer as referring it to as a defect or an error and this, they argue, results in errors not being taken seriously enough.

But how did the word ‘bug’ come to mean a software fault? The first ever bug to cause a computer to behave incorrectly wasn’t an error in the software but a real bug, specifically a moth that had become trapped between the contacts of a relay. The date was 9th September 1947, and the computer was the Mark II at Harvard University.



↑ The first ever software bug, a moth that halted the Harvard University Mark II computer in 1947

## BETA TESTING CAN FIND DEFECTS THAT WOULD NOT BE FOUND OTHERWISE

But while a beta testing programme can undoubtedly reap benefits, it also poses its own problems.

“Beta testing can find defects that would not be found otherwise, but care must be taken lest the users are given a bad impression of system quality, which, in today’s world, they can easily share,” Reid notes.

“A second problem is that users are notoriously poor at reporting defects, which means that many defects go unreported, with users instead spending their time finding workarounds. Often, a more effective approach to beta testing is to use a crowd-testing approach, where typical users are paid to report defects.”

### TESTING TIMES AHEAD

So what of the future? Is software testing a mature technology or is it an area of ongoing research? Reid paints a somewhat mixed picture.

“The practice of software testing varies dramatically from place to place. In some organisations, you’ll find the testers at the leading edge, using AI and

big data to support their testing, while in others it’s like taking a time machine back to the 1970s before many even considered software testing to be a profession,” he tells us.

Interestingly, Reid foresees not so much techniques becoming ever more sophisticated and hence capable for finding ever more errors, but of increasing sophistication having to be used to test progressively more complicated software.

“A good example is AI. AI-based systems create brand new challenges for testers, but AI also opens up new opportunities for both replacing previously manual tasks and performing analyses that were not even possible before,” he says.

A discussion of software quality – or the lack of it – could be depressing, so to close on a high note, we’ll quote Reid’s response to our query as to whether software is of a higher quality than it once was.

“I believe that today’s systems, on average, are of considerably higher quality than their predecessors. As software technology advances, so does software testing,” he explains.

“We have to improve our testing to test ever more complex systems and, at the same time, we try to adopt new technologies wherever we believe they can improve our testing.”








↓ Software testing is increasingly an automated process using tools such as Tosca from Tricentis



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# RETRO

COMPUTING HISTORY REMEMBERED + REBOOTED



## When radio went gaga for computer programs

The sound of a program loading into an 8-bit computer is hardly music to anyone's ears but, as **David Crookes** explains, that didn't stop pioneering broadcasters taking it to the airwaves

**T**here was a time, not too long ago, when children would nip to their bedrooms on a Sunday afternoon, tune into BBC Radio 1 and record their favourite chart tunes on to cassette.

It ended up being something of an art form. Down went the play, record and pause buttons, with the latter released whenever a decent song was played as part of the Top 40 chart rundown. Then it would be pressed again as soon as the DJ began to talk. Time it

right, and their warblings would not be committed to the tape.

In July 1983, however, listeners were hoping to catch a different kind of tune: the sort of scratching, beeping, high-pitched noises that accompanied the loading of software into a computer from a cassette.

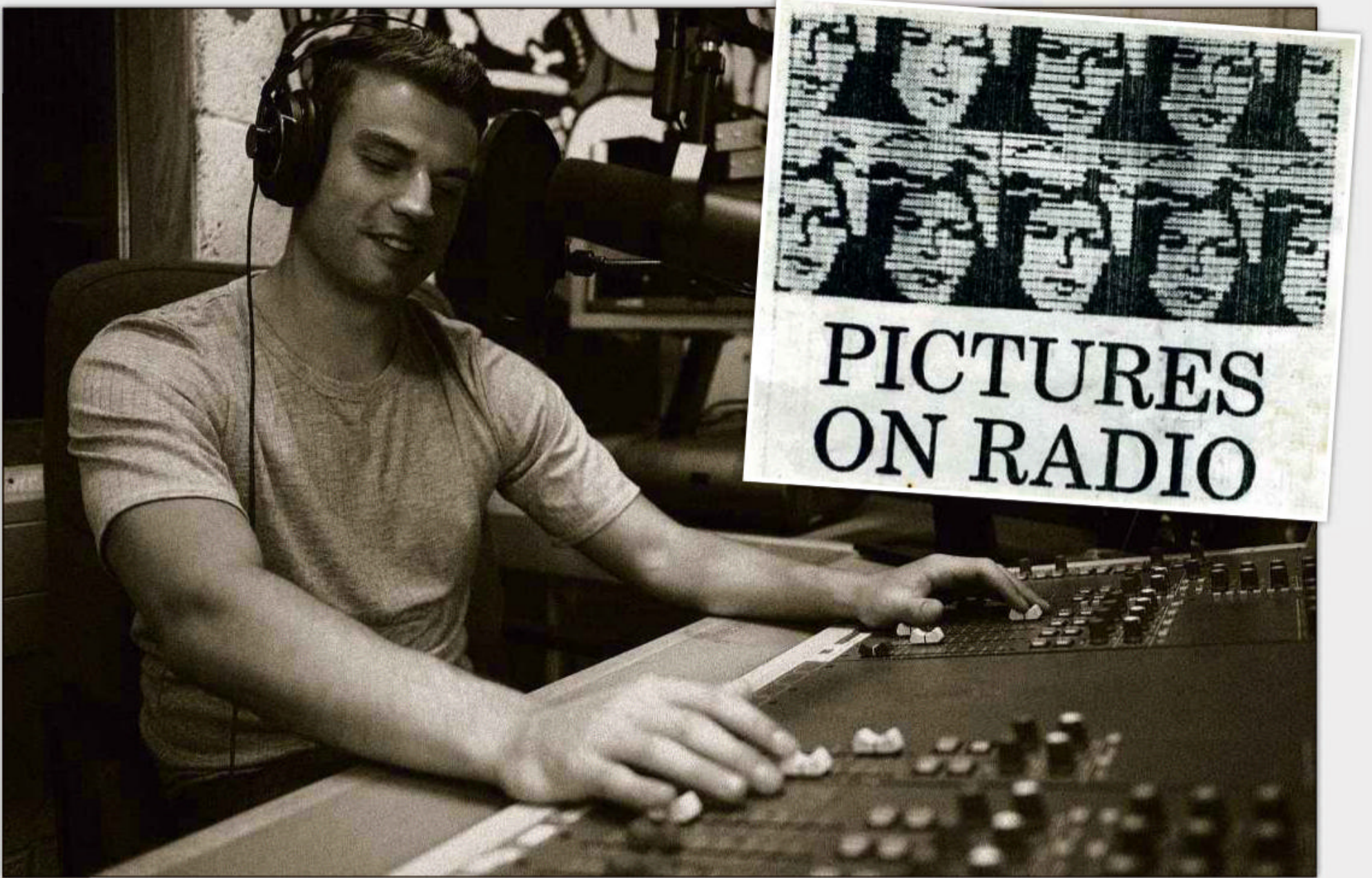
Not for them *True* by Spandau Ballet, The Police's *Every Breath You Take* or Rod Stewart's *Baby Jane*. The big hit in their mind was an image of Cheryl Ladd from *Charlie's*

*Angels* – only they didn't know what they were getting until the sounds were passed into their BBC Micro or ZX81.

The tuneless 'tune' was broadcast across Bristol on the independent station Radio West as an experiment to show that computer programs could be sent over the airwaves.

By loading the streamed data broadcast over both the station's medium wavelength and FM into their computers, listeners would





▲ This newspaper cutting (top) shows the first program to be transmitted by *Datarama* – a chunky Teletext-like graphic of Cheryl Ladd. The program displayed a single pane of the image

see a Teletext-style image inspired by a photograph taken from an edition of the *London Evening Standard* printed in 1975.

"I'd been playing around with microcomputers such as the Tangerine 6502, ZX80 and BBC Micro for a while, and I'd got a job as an audio engineer at Radio West," explains Joe Tozer, who came up with the idea.

"In those days – the late 1970s and early 1980s – micro computers used audio cassettes to store their programs and, since the radio station broadcast audio, I figured we could use the airways to distribute computer programs."

This evolved into the idea for a magazine programme about the evolving world of personal computers. Called *Datarama*, it ended up being broadcast each Monday between 7.30pm and 8pm, and it was Tim Lyons, the station's chief engineer, who pushed the proposal with the programming team.

"The station's programme management was very supportive of the idea because one of the conditions of the station's licence was that it should broadcast innovative and different content," says Tozer.

"It wasn't a station that would just broadcast pop music and phone-ins

presented by DJs, so the *Datarama* idea fitted nicely."

### GOING ON AIR

At first, the pair experimented with a few overnight test transmissions.

"In those days stations would shut down overnight and broadcast a tape loop with the station's ID, test tones, start and end times and other bits of promo information, so we put a segment in the tape loop with an announcement and micro computer data. It worked well immediately," Tozer explains.

## "IT WASN'T A STATION THAT WOULD JUST BROADCAST POP MUSIC AND PHONE-INS PRESENTED BY DJs, SO THE DATARAMA IDEA FITTED NICELY"

But in order to begin broadcasting during on-air hours, they needed to get the nod from the Independent Broadcasting Authority.

"This took a while, so the first three episodes of *Datarama* were just the magazine programme with no computer data included," Tozer recalls. But once they

obtained approval, the gears were set in motion and everything was ready for the show's fourth instalment.

The pair's experiments showed that they merely needed to take an audio cassette containing a computer program and copy it to the reel-to-reel tape that *Datarama* was recorded on to. This didn't require any tweaks and, to the pair's surprise, the signal was more robust on the AM signal when compared to FM.

"This was probably due to the high levels of audio compression used," Tozer says.

A local newspaper article claimed the broadcast was about to make history, becoming "the first in the world to transmit data information that can be programmed into computers during a live programme".

This wasn't strictly true. On 15th December 1977, *Computer Shopper's* very own Mel Croucher had broadcast a videogame





238 metres/1260 kHz medium wave 96.3 MHz FM stereo

↑ Radio West began broadcasting in 1981 as a competitor to BBC Radio Bristol, with *Datarama* going on air two years later. It closed in 1985

over the airwaves, making use of Radio Victory's 257FM waveband as well as the medium wave in the south of England.

PET owner Croucher had been given a job creating a series of radio pub quizzes, and he decided it would be a great idea to distribute a puzzle quest game on air, have listeners load it, solve it, and call the radio station with the answer.

Croucher had formed the UK's first dedicated videogame company, Automata, with Christian Penfold, and the broadcasts became a regular gig every Thursday night as its popularity grew. Prizes were handed out to those who managed to ring the station with the correct answer first, and the broadcasts continued for years.

*Sinclair User* revealed news of a competition, which began on the station on a Saturday in June 1983, describing how the program would include a screen of text,



↑ Joe Tozer put a segment of computer code in the radio station's tape loop

the Radio Victory logo and the line of a famous song beneath it. By guessing the title of the song and calling up DJ Dave Carson, they'd win a £5 gift token.

Then, in the same year, the Dutch broadcaster Nederlandse Omroep Stichting began transmitting software on a radio show called *Hobbyscoop*. What's more, that

show's producers had gone to the bother of commissioning the development of a tape format called BASICODE, which allowed data and programs to be shared across different 8-bit platforms.

Such a need became obvious as they'd found the need to air numerous versions to suit different computers – notably the Tandy



↑ Mel Croucher (centre) was the first person in the world to transmit computer programs by radio in 1977







↑ Educational program code aimed at teachers and students proved the most popular broadcasts on Radio West

TRS-80, Commodore PET, Apple II and Exidy Sorcerer – to be rather cumbersome.

By creating an Esperanto-like coding system and having it in place in 1982, the Dutch broadcasters needed to air only one set of code, which could be run through a translation app called Bascoder, produced for each machine (for good measure, the

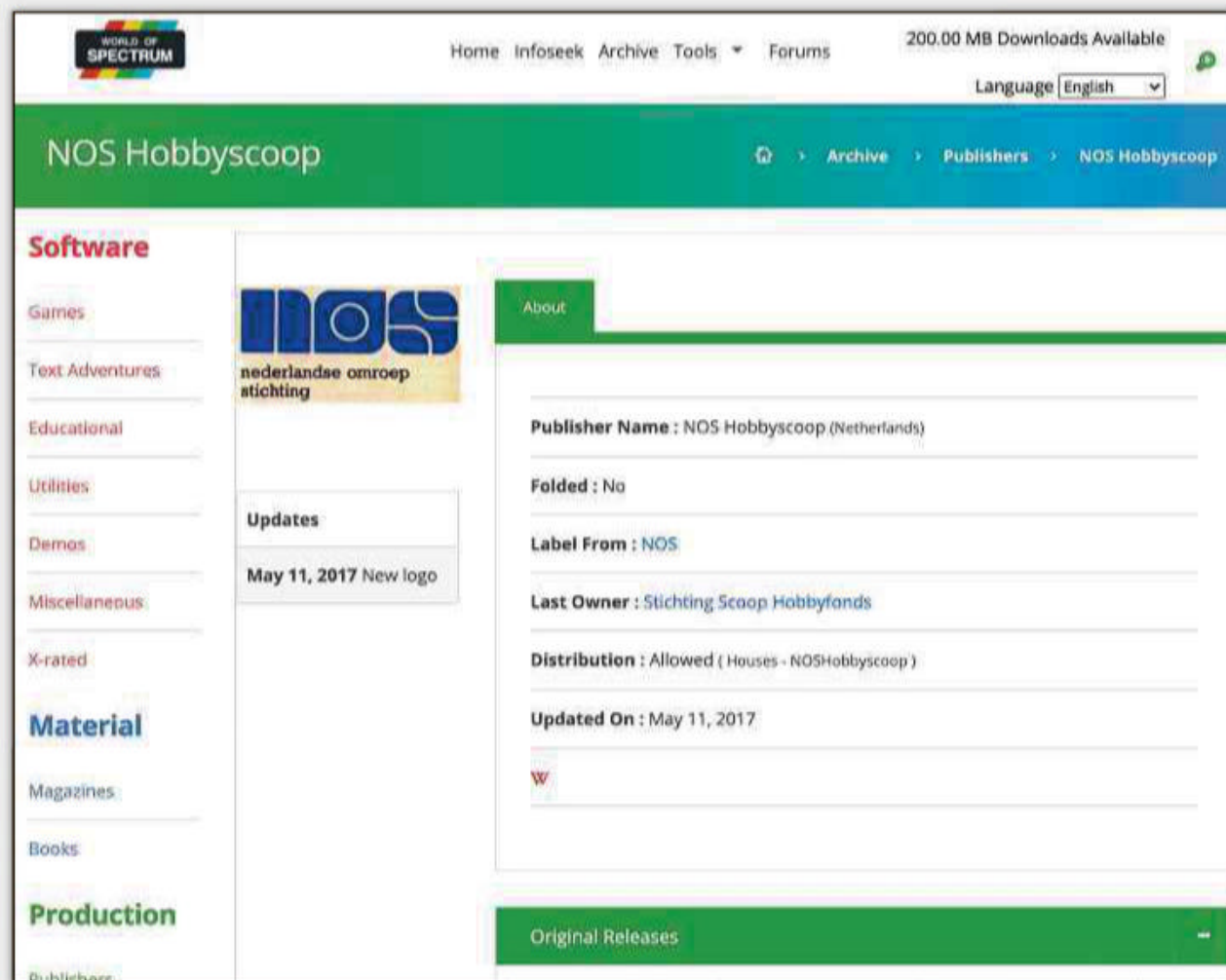
Bascoder apps were also broadcast). They refined this in 1984 with BASICODE 2, and it went down very well with listeners.

### GETTING FEEDBACK

Tozer was not aware of these initiatives. “We were all in our little local bubbles, so knowing what might be happening elsewhere on the

planet, or even in different parts of the UK, in those times was almost impossible.”

Similarly, Simon N Goodwin, co-presenter of *The Computer Show* on Radio Wyvern, didn’t know about Tozer’s broadcasts when he sent an animated BASIC Christmas card to Tandy TRS-80 and Spectrum users in 1983 – the same year, incidentally, that the *Ventilator*



↑ Visit World of Spectrum ([tinyurl.com/394retro1](http://tinyurl.com/394retro1)) and you can download software broadcast by Hobbyscoop in the Netherlands



➔ Reports of Datarama were printed in many computer magazines of the time, including this one in the July 1983 issue of Sinclair User

202 show on Radio Belgrade began broadcasting Speccy games before branching out with a host of software. In all cases, listeners could plug their computers into the headphone jack of their radio to run the computer program immediately or record the software on to cassette and play it back later. Most of the software that ended up being broadcast was written in-house or by listeners.

“To avoid copyright issues on Datarama, all the content for broadcast was written by myself and Tim,” says Tozer.

So did some programs work better than others? “From a technical point of view, all computer programs worked equally well, as they are all just the same set of audio tones that contain the data,” Tozer explains.

“From a content point of view, the most popular content was educational stuff aimed at teachers and pupils. The only one I clearly remember was a Morse code generator that took keyboard text and played it back as Morse. Since it was for schools I’d hidden a profanity filter in the code to prevent naughty words being played, and I got a letter from a local school teacher roundly thanking me for including it.”

Indeed, the broadcasts were so well received that Tozer can’t recall receiving any complaints, although you do have to feel for



anyone who inadvertently switched on at the time of the data broadcasts, perhaps baffled as to what they may have been (some new-fangled dance music, perhaps?).

“The feedback we received through the post – snail mail, as there wasn’t any email in those days – was unrelentingly positive and enthusiastic,” Tozer recalls.

“We seemed to hit a chord with listeners.”

Datarama ran for a few years, its magazine format mixing news, games reviews and letters with short and long tech-based features on topics such as the music industry, business and schools, as well as hints and tips.

“The live broadcast of the bleeping noise was kept relatively short to avoid annoyance,” Tozer says.

# NEWS

## MANAGE ADF FILES ON AN AMIGA

Look for Amiga software online and you’ll find that programs generally come in the form of floppy disk images, or ADF files as they’re known to the computer’s still bustling community. This uncompressed format replaces floppies and can

be used within an emulator on a PC or Mac. But getting them to run on a real-life Amiga is a little trickier, which is where the shareware application GoADF comes in.

Running on the Amiga, it provides a management solution for the ADF format, letting you see and explore the available files, read information and even mount ADF drives on a hard drive attached to Commodore’s

celebrated machine. You’ll need an Amiga with at least a 68000 CPU, 1MB RAM, Kickstart 2.0, a hard drive and a couple of libraries, but having quick access to ADF files and the ability to copy files to real

media makes this a must-have tool. Go to [www.bitplan.pl/goadf](http://www.bitplan.pl/goadf) to find out more.

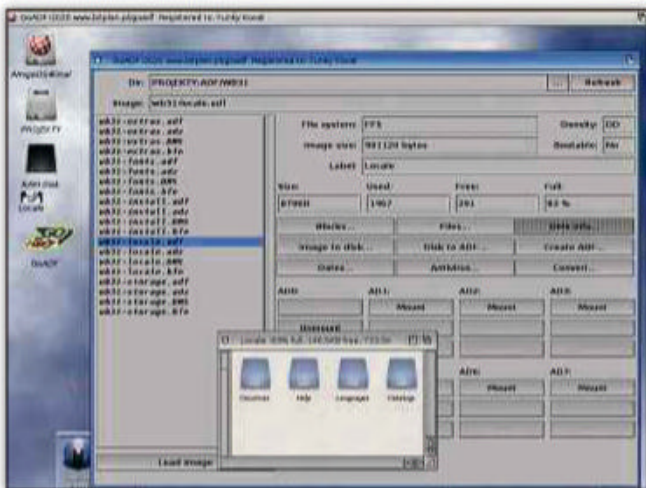
## CREATE A DIGITAL TAPE EMULATOR

Many modern Spectrum owners use a device called a TZXDduino, which plugs into the 3.5mm audio input port of the 8-bit computers and allows the reading of .TZX and .TAP files directly from an SD card. It’s marketed as a replacement for a cassette player, but some users feel it loses the charm of running games from tape.

Step forward this amazing little hack by a fellow going by the name of JamHamster ([tinyurl.com/394retro2](http://tinyurl.com/394retro2)). His T2XCassette creates a battery-

powered virtual tape deck by squeezing TZXDduino hardware (which includes an Arduino Nano and a microSD card reader module) into the shell casing of a cassette, while making good use of a recovered tape head from a car cassette adaptor.

Users select a file by pressing a button and viewing the name on a 128x64 display. The tape can then be







↑ Programs were originally broadcast for the ZX Spectrum and BBC Micro computers

“Then, overnight, we played what were called the ‘night tapes’, when the station was off air. These had more, and longer, programs for more types of computers.”

In between, there would be specialist advertising from local shops that sold computers, including Dixons (“the station’s commercial management were happy with

that aspect,” says Tozer, who left after the first dozen or so episodes, replaced as co-presenter by Martin Schimmer).

But Tozer’s fondest memory is of that first broadcast, which he can recall as though it was yesterday.

“Radio West had been heavily bigging up the novel computer data aspect ahead of the

first transmission, and on the day of the first data broadcast, after the programme had finished, I recall one of the station’s journalists, David Garmston, was seriously less than impressed, saying: “And now the moment you’ve all been waiting for: BEEEEEEEEEEEEEP BEEP BEEEEEEEEEEEEEP. Was that it?” **CS**

popped into the cassette deck and the file will be loaded into the Spectrum. You can find instructions at GitHub ([tinyurl.com/394retro3](https://tinyurl.com/394retro3)) if you fancy having a go.

JamHamster says that he’s also considering creating a small production run and popping a few on eBay with a view to creating a Kickstarter project.

● **CPC GAMES COMPETITION IS UNDER WAY**

It’s game on yet again for Amstrad CPC owners as the eighth edition of a popular videogame development contest gets under way.

CPCRetroDev 2020 is once again challenging game creators to push Lord Sugar’s range of computers to the limit, with cash prizes being offered to the best



titles as judged by a panel from the University of Alicante.

The deadline is 1st November, so if you fancy entering then you’ll have to be quick. The awards will be announced on 13th November, and they generally result in 40 or so original games being released for free, with past gems including Miss Input, Operation Alexandra and Babas Palace. Find out more by going to [tinyurl.com/394retro4](https://tinyurl.com/394retro4) (use Google Translate if you don’t speak Spanish).

● **NATIONAL VIDEOGAME MUSEUM IS DOOMED**

First of all, don’t worry: this isn’t a news story about the demise of the UK’s fantastic National Videogame

Museum in Sheffield – in fact, as of 22nd August, the NVM has been back open for business – check out [www.thenvm.org/blog](http://www.thenvm.org/blog) for more details.

Rather, this is about the National Videogame Museum in Texas, which has been re-created as a level in DOOM 2.

Produced by Chris Baracani, who co-owns DevHour Games, it allows visitors to gently peruse the exhibits in Tourism Mode or else blast demons if you’re feeling up for some action.

Download the mod from [tinyurl.com/394retro5](https://tinyurl.com/394retro5), where you’ll also find a couple of secret maps added by request to the NVM’s owners. The 1980s arcade and the timeline of console releases are certainly worth a look.





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## Router finding

I read your review of routers and mesh systems in *Shopper 390*. My wife and I have both been working from home due to the pandemic and I am trying to revamp our home internet connectivity with an Asus ZenWiFi AX dual-node system.

I've not seen anything recently in the magazine to explain how you're meant to set up this kind of equipment with an ISP-provided router. We have Vodafone's Superfast 2 broadband with what the mobile operator calls the WiFi hub – it's a combined modem and router. I thought it would simply be a case of connecting the ZenWiFi to a port on the Vodafone router with an Ethernet cable, but I'm encountering terms I don't really understand, such as 'double NAT' and 'bridge mode'.

Unlike our previous Virgin router, the Vodafone hub doesn't seem to have a modem mode. I've contacted Vodafone and Asus technical support, but neither of them can explain how best to set up the devices. I'm particularly confused as to whether I should connect my Asus router to the Vodafone router using its WAN ports or LAN ports. Can you help?

Alex Davies

Home hubs provided by the major ISPs are usually fairly restricted, and it appears that Vodafone's example doesn't have a modem-only mode. Assuming that's correct, there are two main ways to set up your devices.

Number one is to use most of the features of the Vodafone hub while using the Asus system only as a powerful wireless access point. Doing this involves logging into the Asus management interface, entering the LAN settings and setting the router's IP address so that it's within the range being used by your Vodafone hub. Before applying the change you should also turn off the DHCP server, then view the Clients page on the Network Map and note down the LAN MAC address shown for the router. You should also configure the wireless network if you haven't already.



↑ Find the Asus router's MAC address in the Clients page on the network map

On the Vodafone hub, use the drop-down box at the top of the admin interface to select Expert mode. Use the options to reserve the IP address that you allocated to the Asus router, providing the MAC address you noted down if required. Then connect an Ethernet cable between a port on the Vodafone hub's switch and a switch port on the first Asus router; don't use its WLAN port.

At this stage, you should be able to connect to the Asus router's wireless network and access the internet. Assuming this is the case, you can log back into the Vodafone router and switch off its wireless network.

The alternative configuration would be to connect the Vodafone router to the Asus

router's WLAN port, but without bridge mode this is far from ideal. The Vodafone router's firewall would be applying network address translation, designed to 'hide' the devices on your network from direct internet traffic. However, the Asus router would be doing the same. This 'double NAT' configuration can make it complex or impossible to allow services through the firewalls.

The best alternative to either setup is to buy the cheapest VDSL router you can find with a modem-only mode. Configure it for the Vodafone service by searching the Vodafone forums for **VDSL settings**, then connect a port from its switch to the Asus router's WLAN port and configure this as you want it.



# Light reads

I've noticed that I can buy books in an electronic format for much less than printed books. I spend 14 weeks in France each year and the rest of my time in the UK. It would be useful to be able to read ebooks in both countries, as that would save me having to carry actual books backwards and forwards. Is there a program that I can install on my Microsoft PCs that will let me read them? If I knew the format of the ebooks I could even write my own reader software. Can you help?

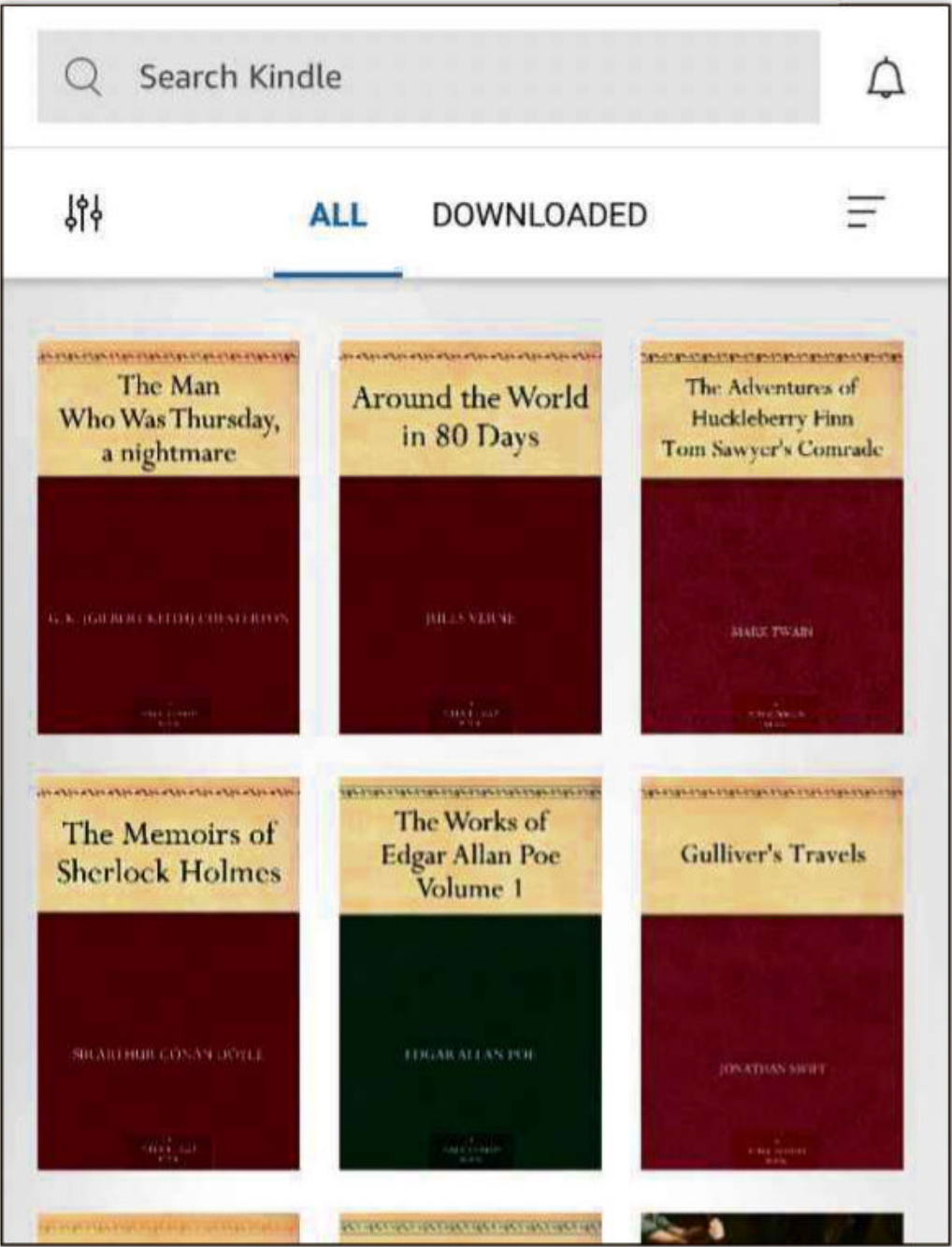
Robert Gordon Smith

Probably the simplest option would be to buy the Kindle edition of books via Amazon. Although it's a proprietary system (you'll need Kindle software or a Kindle reader to access the books), there's a wide range of reasonably priced publications available. Perhaps as importantly, it's simple to browse your library and read directly from your devices. There are apps for PC, Mac, iOS and Android, and a range of purpose-built readers with E-Ink screens.

There are alternatives if you don't fancy committing to Amazon, such as Kobo's similar ecosystem. In both cases you can 'sideload' other ebooks that you've downloaded elsewhere, provided they're in a supported format and not protected by digital rights management. This would let you take advantage of other sources, such as the large library of free ebooks from Project Gutenberg ([www.gutenberg.org](http://www.gutenberg.org)).

It's worth pointing out that you can download many ebooks in PDF and other widely supported formats, letting you read them with free software you might already have. Most readers (Kindle excepted) support the ePub format, based on HTML. It's an open format, which might make it a suitable choice if you do want to try writing your own reader app.

➔ It's hard to beat the Amazon Kindle ecosystem, but there are alternatives



# Age concern

I live on my own and am of advancing – nay, advanced – years. It sometimes crosses my mind that, should I have a nasty turn or possibly a fall, nobody would be any the wiser until it was too late. The obvious answer is a mobile phone, and indeed I have a smartphone that does many brilliant things. However, it is so brilliant, that in fear of dropping it into the pond or compost heap, I tend to leave it on the kitchen table.

A better solution would be a smartwatch with the facility to send out an emergency signal to one or more contacts. But while it seems that wearables can all monitor my idleness, fitness and even impending diseases, they lack the single feature I need. Does anything fit the bill?

Name withheld



➔ It's not an Apple Watch, but Age UK's wrist button isn't too offensive

It's not something we've focused on in reviews, but in fact it is possible to turn a standard smartwatch into an emergency call button. Since the fourth generation, the Apple Watch has had built-in fall detection, which can be configured to notify contacts and even the emergency

services if you don't respond. Samsung's Galaxy Watch 3 has a similar feature.

One potential drawback of relying on a smartwatch is that it needs to be connected. You'll either need a watch with its own mobile connection, or you'll need to be within Bluetooth range of your phone, or able to

reach your home's Wi-Fi. If it's critical that you should be able to summon help, we'd recommend considering a purpose-designed, standalone product. While we haven't tested it ourselves, Age UK offers a personal alarm service with a choice of wrist or pendant-based alert buttons.





↑ The Pixma TS705 has a five-ink setup, with pigment black usually used on plain paper

## Acetate modern

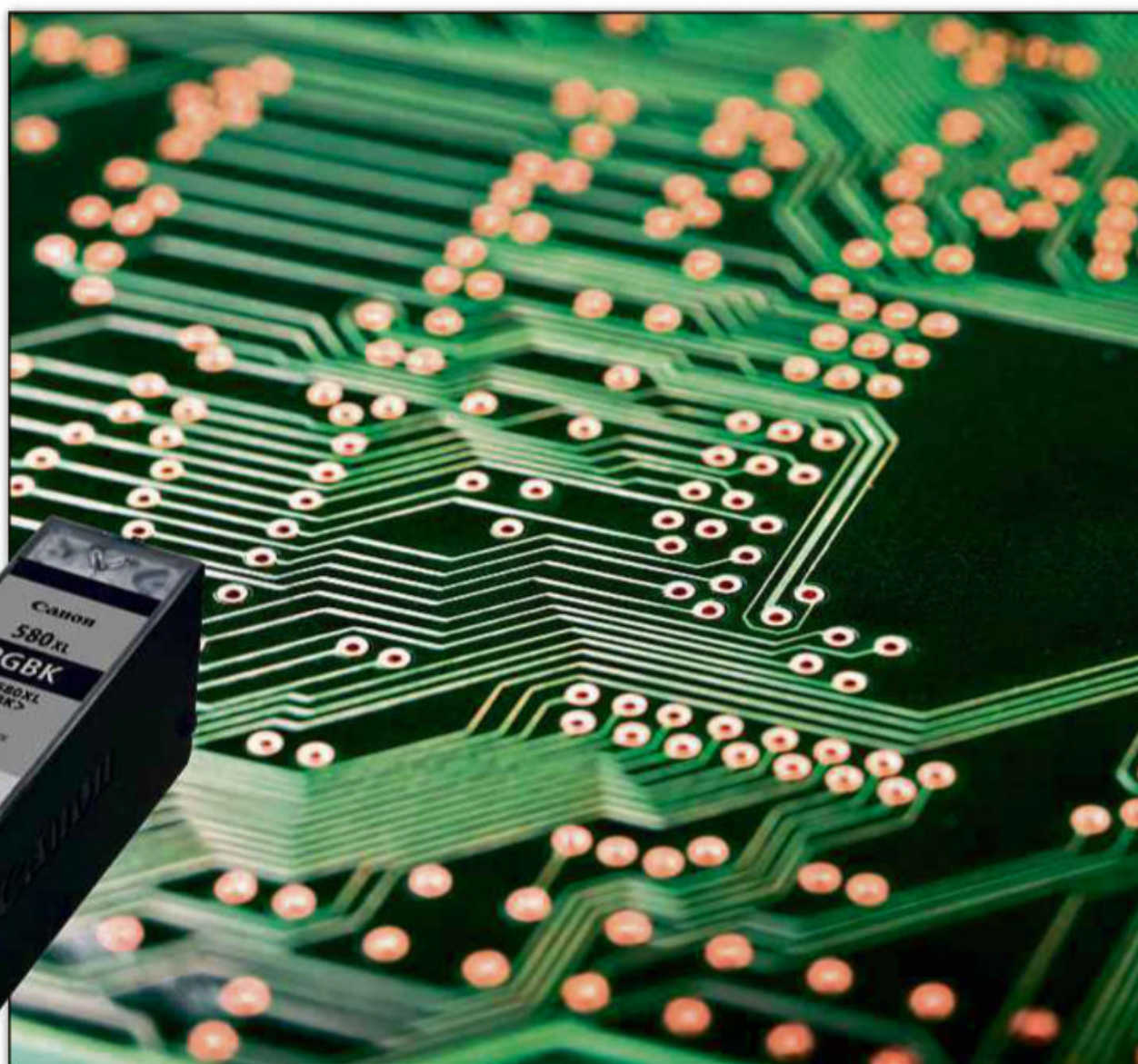
Recently, my old Canon Pixma iP4200 died. One particular job I found that this printer was very good at was producing artwork on acetate for printed circuit board (PCB) production. In Best mode it would print very sharp, dense black. Please could you recommend a replacement? I have tried a couple of other printers, but they couldn't match the Canon.

*Derek Jones*

The Pixma iP4200 used a five-ink setup, which paired dye-based black, cyan, magenta and yellow inks with a pigment-based black ink. Depending on the paper you were selecting in the driver, it's likely that you were getting strong blacks from this pigment ink.

The iP4200 may be long dead, but Canon's five-ink system lives on. Most affordably, you'll find it in the Pixma TS705 single-function printer, which costs around £60. While we haven't specifically tested this model with acetate, we'd expect it to match the print quality you had before. 🖨️

➔ Canon's pigment ink might be responsible for dense black prints on acetate



↑ You'll need a dense black ink for printed circuit board production





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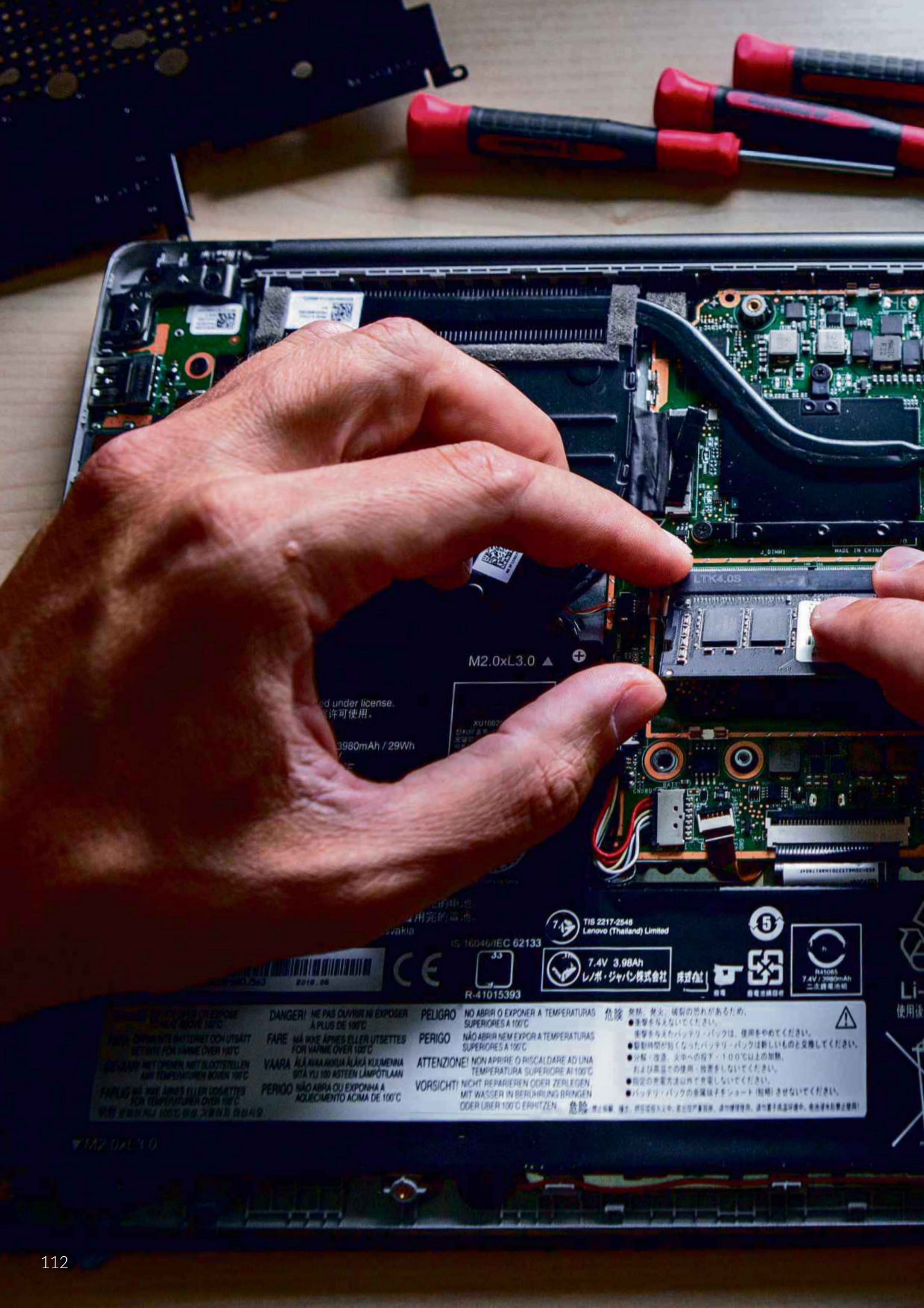
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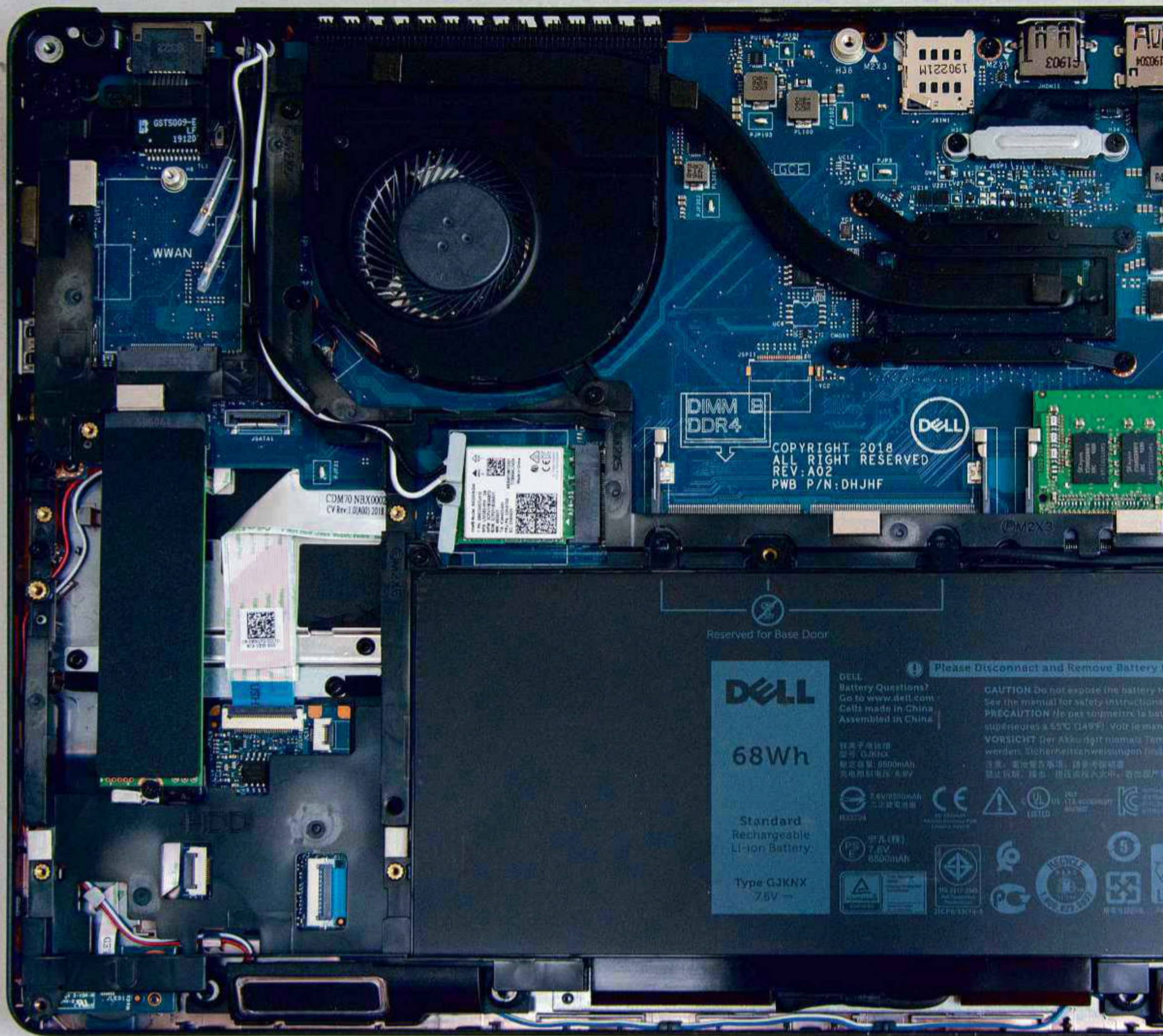




# UPGRADE YOUR LAPTOP

Rather than a useless box that has to be thrown away, laptops can often be upgraded and improved. **David Ludlow** shows you how to give your notebook a new lease of life →





**ABOVE:** This laptop has a removable back panel, which gives you access to all the components

## INTERNAL UPGRADES

Most of the upgrades you'll want to do will take place inside the laptop, including Wi-Fi card, memory and storage. In this section, we'll take you through how to perform each one, but we have to say that not all computers can be upgraded in this way.



**W**hile laptops may feel like a different beast to a desktop computer, sold as a single device, they still share the same base DNA. In many cases this means that a laptop is upgradable, just like a desktop computer, letting you change storage, boost wireless performance, upgrade memory and more. Even if you can't get into your laptop, there are often some clever external upgrades, too.

In this guide, we'll take you through all of the main upgrade options and how to perform them, so that you can make your laptop better and keep it going for longer.

**RIGHT:** Don't get frustrated by your old laptop - there are lots of ways you can boost performance

Slimline ultraportable laptops and tablet convertibles, such as the Microsoft Surface Pro, are packed into sealed cases. Memory and storage are often soldered to the motherboard, preventing any future upgrades.

Traditional-style laptops with slightly thicker cases are usually upgrade fodder. These models are typically provided barebones to the manufacturer, which then adds the requested storage size and memory at the point of purchase. We'll show you how to tell the difference and work out if you can make an upgrade.

## Opening your laptop

How you open your laptop depends on the model. Before you start, you should properly shut down your computer from Windows so that the power is off. Most modern laptops



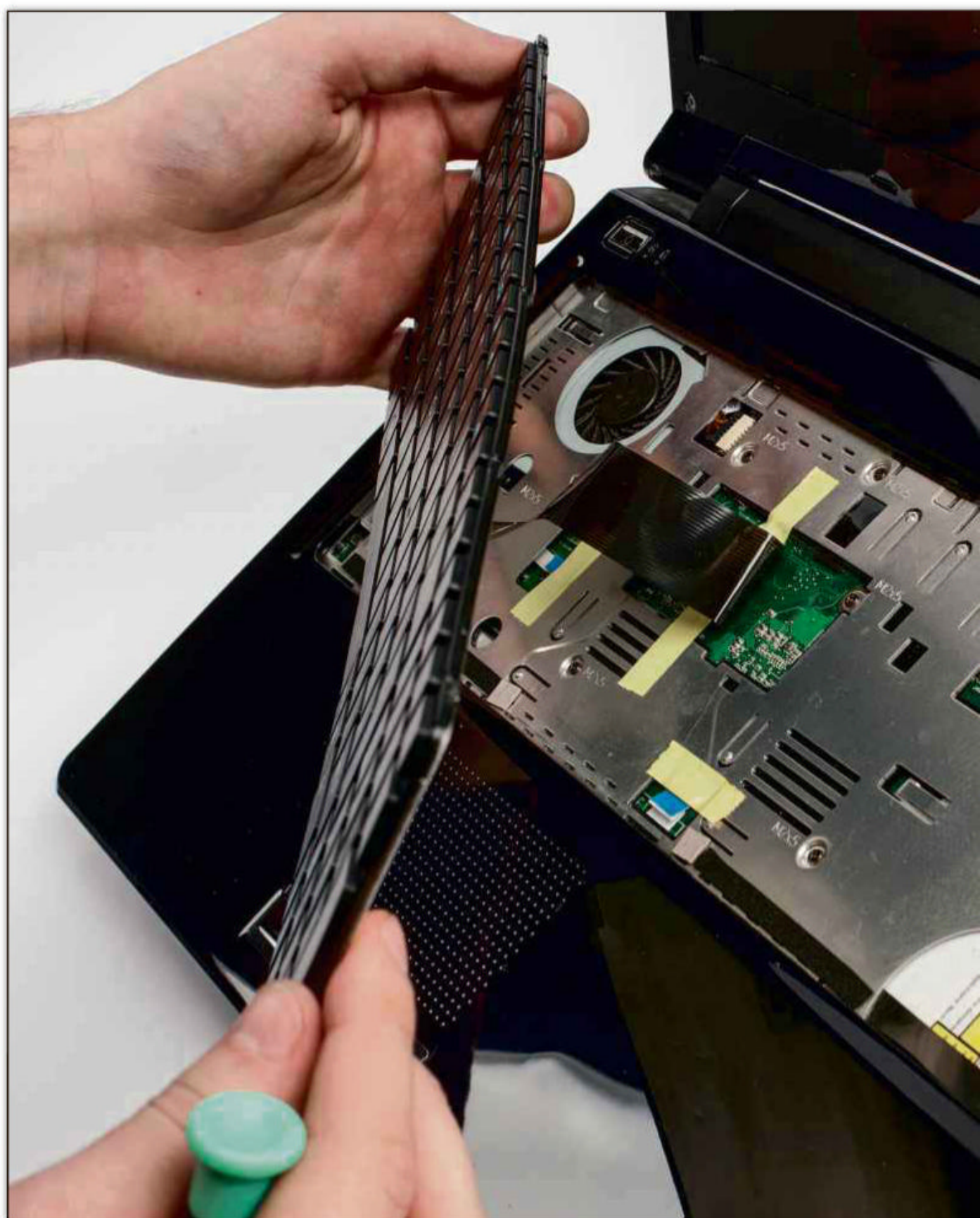


will have access underneath. If you can unscrew the entire back panel, then you'll get access to all the components. Make sure you undo any screws in the side or rear of the laptop, then gently lever up the sides to remove the retaining clips.

If you've got individual panels, then you can remove the retaining screw to access the RAM, storage and Wi-Fi modules individually.

Some older laptops may give you access to components through the keyboard, particularly for RAM. You'll need a small flathead screwdriver to push in around the notches in the keyboard. Use the screwdriver as a lever to unclip the keyboard and remove the keyboard unit. Be careful not to stress the ribbon cable that attaches the keyboard to the computer.

Laptops can have components hidden in multiple locations, so you may find a



**ABOVE:** Some laptops require you to remove the keyboard to access components

panel underneath for storage, but RAM underneath the keyboard.

### Upgrading memory

If your laptop doesn't have enough memory, you may struggle to open all of the apps you need, and it can make your computer feel slightly sluggish. As a minimum, we recommend having 8GB of RAM, but go for 16GB if you really push your laptop to its limits.

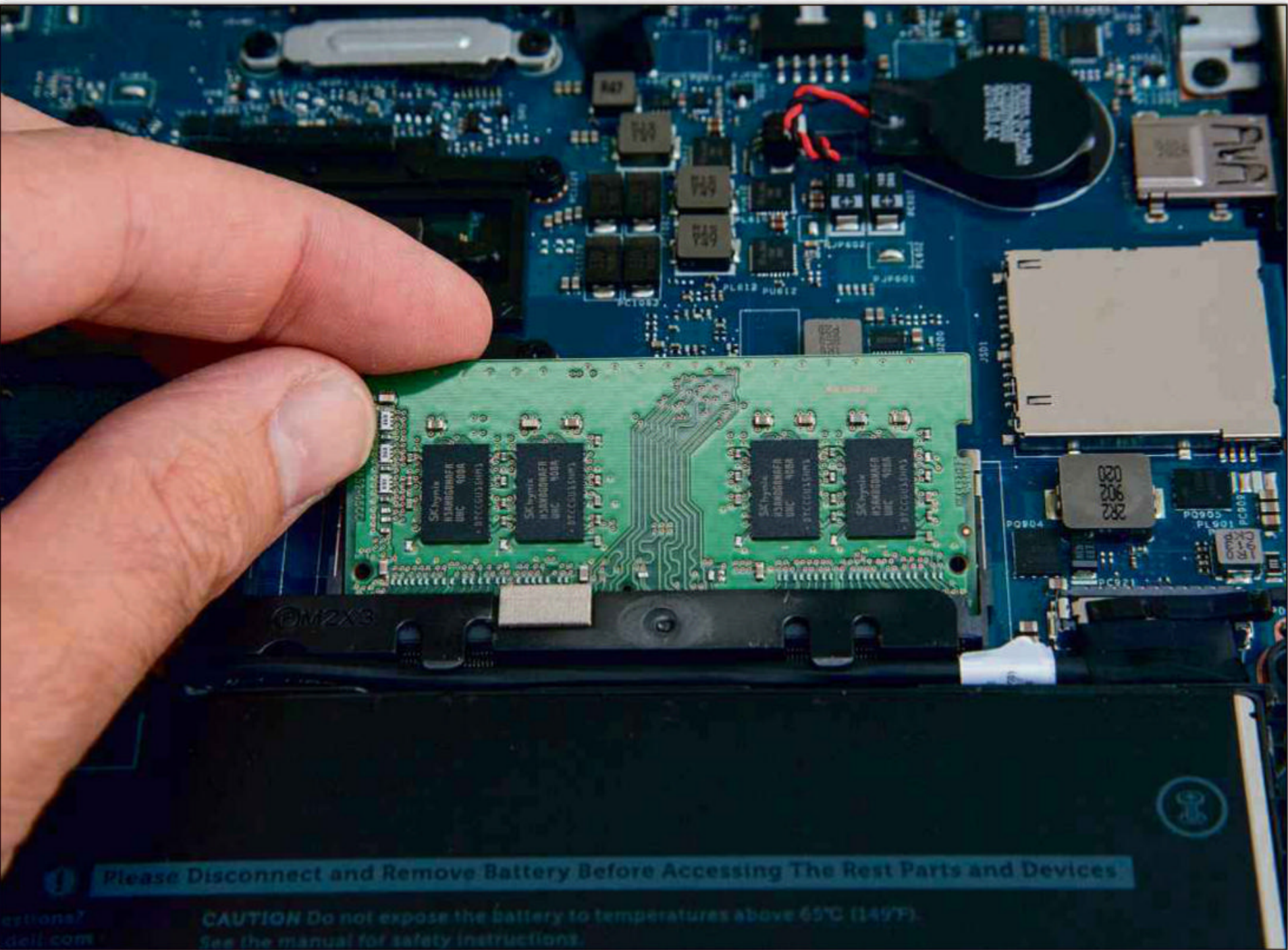
The easiest way to check if your laptop is upgradable is to use the Crucial System Advisor ([uk.crucial.com/store/advisor](http://uk.crucial.com/store/advisor)). Simply enter your laptop's details into the box and select Find my computer, and Crucial will come back and tell you if your laptop is upgradable, how many slots it has, and the maximum amount of RAM you can install. You'll also get a list of compatible

memory sticks that Crucial sells, although you can buy them from other manufacturers.

It's best to buy RAM in pairs of the same type and speed. Remember that laptops use smaller memory modules than desktop computers, so you'll need to buy SODIMMs. A 16GB kit of DDR4 RAM should cost around £55.

If you're removing your old RAM, you need to open the clips on the slide to let the memory pop up. Then gently slide it backwards. Next, you can install your new memory modules. You need to insert the memory at roughly a 30° angle, lining up the cutaway in the middle with the notch in the RAM slot. Once the connection is firmly made, push down on the RAM to lock it into place; the clips will close around it. Repeat if you have a second stick of RAM. You can now reassemble your laptop and turn it back on. ➔





**ABOVE:** Carefully insert your new RAM, then press down to lock it into place

Upgrading Wi-Fi

If you want to use Wi-Fi 6 because you’ve bought a new router, you may need to upgrade your laptop in order to take full advantage of the latest standard. To do this, you need a laptop with an M.2 slot that matches the Wi-Fi card pictured opposite. There’s a bit of additional complexity to this procedure. The Killer 1650x card

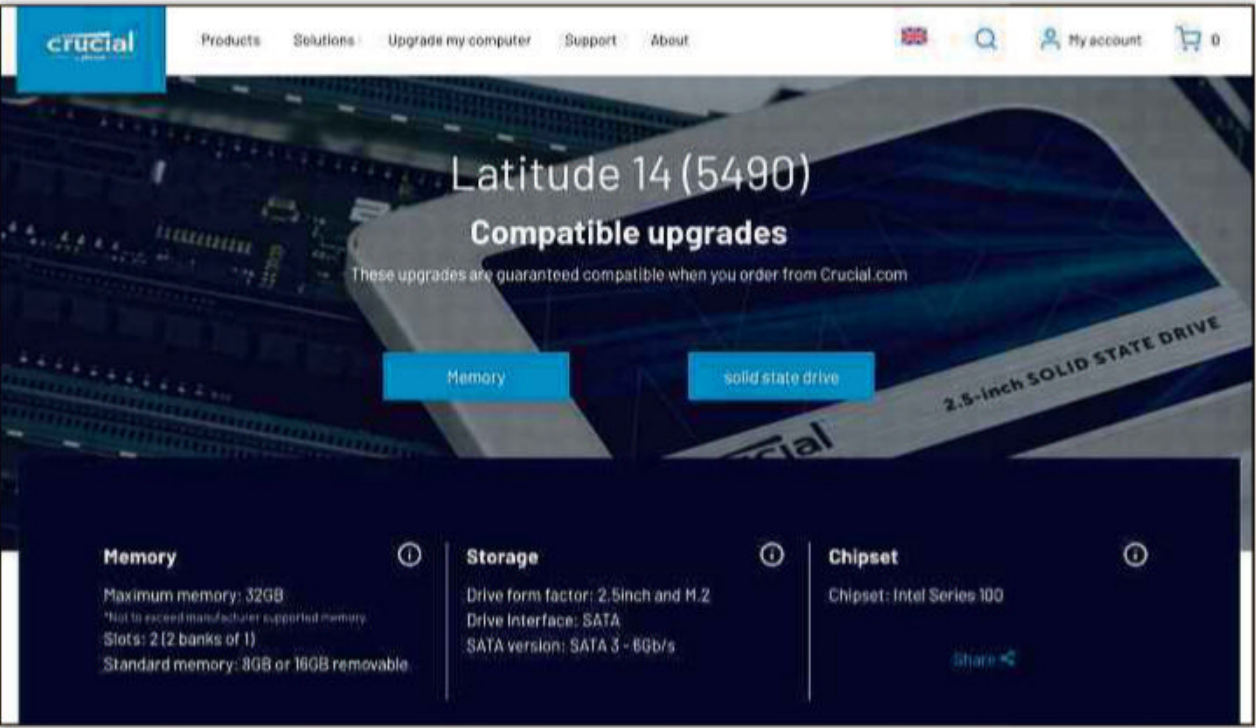
(pictured) is designed to be used with any laptop and costs around £35 from [www.amazon.co.uk](http://www.amazon.co.uk). You can get the cheaper Intel AX200NGW instead, but this requires your laptop to support CNVi, whereby some of the tech usually installed on the Wi-Fi card is installed on the motherboard. Typically speaking, computers from 2018 and later support CNVi.

In both cases, the installation is the same. First, you’ll need to download the drivers for your new Wi-Fi card. Then, take your laptop apart to get to the Wi-Fi card slot. Remove the retaining screw, gently unclip the antenna connectors (the two wires), then slide the old card out. Put the new card in place, reattach the cables, then screw it back into place. Reassemble your laptop, turn on your computer, install the drivers, and you’ve now got Wi-Fi 6.

Upgrading your hard drive

If you’ve got an old hard disk in your laptop, an SSD can improve boot-up times and responsiveness; if you’ve got an SSD already, a new one can give you more storage space. Once you’ve taken your computer apart, you can see what type of hard drive you have. Traditionally, laptops used 2.5in hard drives. These can come in hard disk or SSD formats. Newer computers use the modern M.2 interface, where the SSD looks like a long stick of RAM. These slots can usually take

**LEFT:** Crucial’s online tool tells you if your laptop’s RAM can be upgraded







**ABOVE:** Upgrade your laptop with a card such as the Killer 1650x to get Wi-Fi 6 speeds



**ABOVE:** You can replace your existing Wi-Fi card to get faster speeds

M.2 SATA drives, which are slower but cheaper, or M.2 NVMe drives, which are faster but more expensive. However, the interface is the same. Just take a note of the type of drive you buy.

Once you know which type of drive you have, you can buy a replacement. We recommend that you go for a minimum of 256GB, but 512GB or 1TB is better. Most importantly, if you're upgrading from a hard disk, don't buy an SSD that's smaller, as you'll immediately want more disk space.

The best way to get a new hard drive set up is to clone it, copying everything from the old drive to the new one. As you can't have more than one hard disk in a laptop, you first of all need to buy an external enclosure for your new drive. An M.2-to-USB adaptor for SATA drives costs

around £14 on Amazon; NVMe-to-USB adaptors are around double the price.

If you have a 2.5in drive, you need a regular SATA-to-USB 2.5in converter, which should cost you around £7. Power on your laptop and then connect your new SSD via the external adaptor.

Download and install EaseUS Todo Backup Free from [easeus.com/download.htm](https://easeus.com/download.htm). This will also try to install some additional software, so make sure you select any 'Click here to customize

installation' links and untick all the choices to install any optional software.

Start Todo Backup Free and select the Clone option. Select your source disk by putting a tick in the square tickbox. You can identify disks by looking at the drive letters they use. The boot drive has the C: drive letter, for example. Click Next and select your new disk as the destination.

Acknowledge the warnings about your data being erased and wait for the clone to complete. This could take several hours.

Now, turn off your computer, take your laptop apart and remove the old hard disk. For 2.5in drives, you need to remove any retaining screws. Then, slide out the old hard disk, removing it from the SATA port. If the disk was in a caddy, then unscrew and remove it.

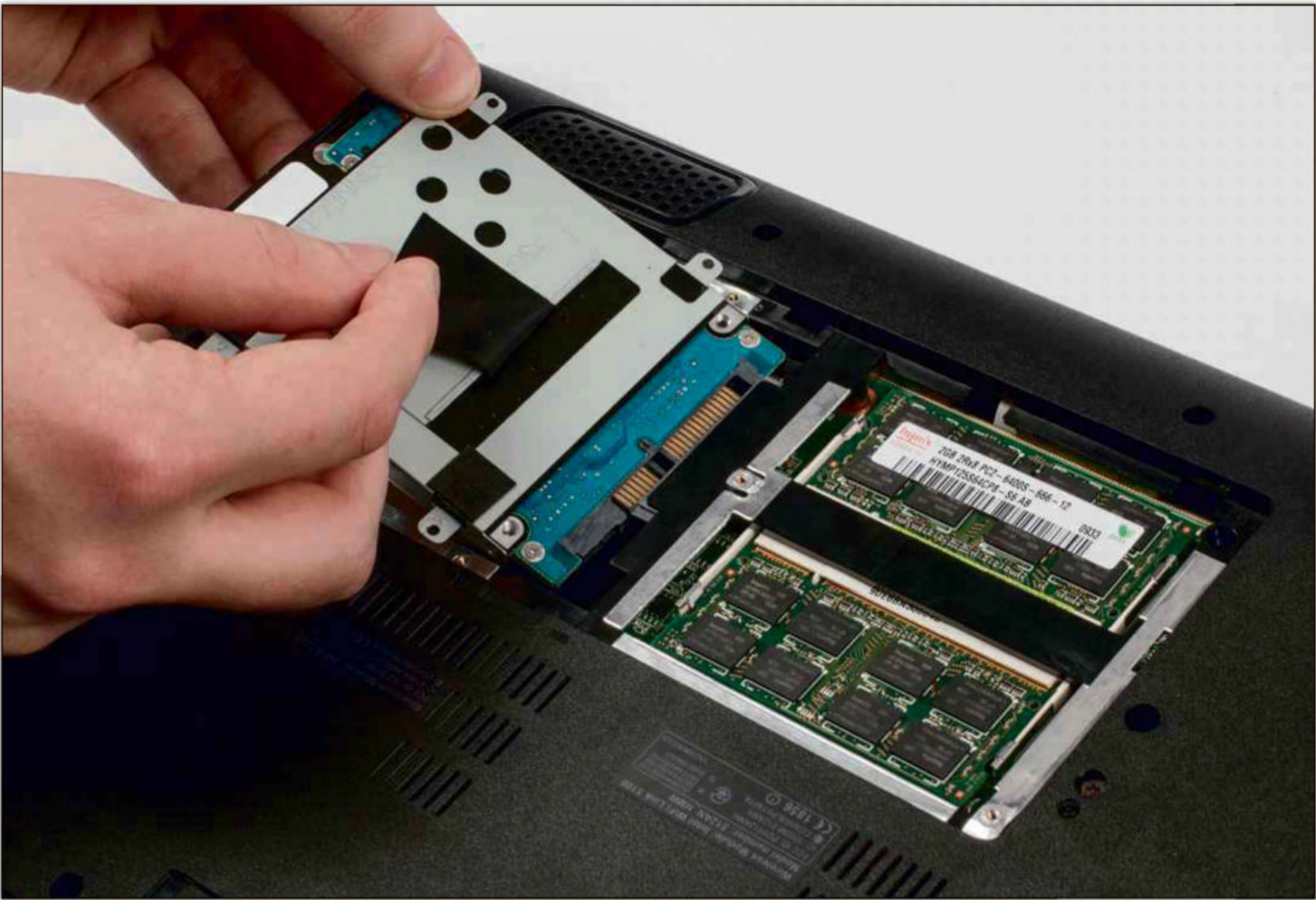
Put your new hard disk in the caddy and secure it with the screws (if required).

Insert the new hard disk into the laptop's drive bay. Reattach the panel and switch on your laptop. For an M.2 drive, you need to remove the screw, which should make the drive pop up a little.



**LEFT:** A simple USB-C dock is a great way to expand your laptop's options





**ABOVE:** Remove your old hard disk from the case, and remove the drive from a caddy (if it's installed in one)

Now gently pull the drive out backwards. Next, take the new M.2 drive and slide it into the empty port, push it down and screw it back in place. Reassemble your computer, turn it on, and you're done.

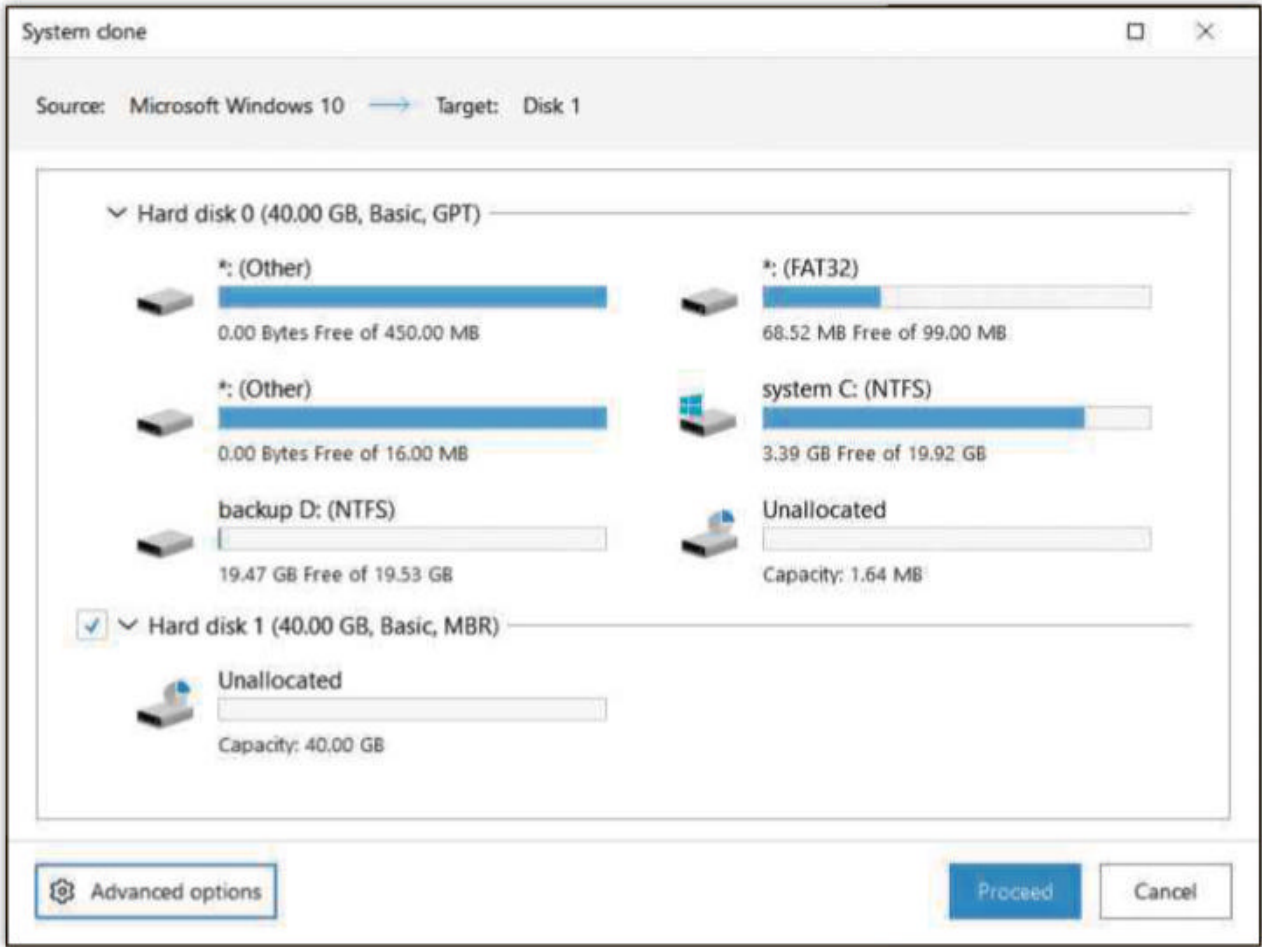
EXTERNAL UPGRADES

If you can't open up your laptop, or if all of the key components are soldered on to the motherboard, you still have the opportunity to make some external upgrades, which we'll look at here.

SD cards as storage

Many laptops have an SD card slot, while some, such as Microsoft's Surface Pro, have a microSD card slot. These are designed as both a card reader and a way of quickly adding storage. A 256GB SD card with up to 100MB/s read rates costs around £28, but we'd advise paying a little more for a faster 170MB/s card, such as the SanDisk Extreme Pro. MicroSD cards cost a similar amount.

All you have to do is slide the chosen card into the slot on your laptop, and you've boosted the storage space that you can use. As this is removable storage and you may



**ABOVE:** You can use Todo Backup to clone your hard disk for free

want to use your slot as a card reader, there are a few things to watch out for.

First, don't install applications on the card, as you'll lose access to them if the card is removed, and performance will also suffer. Memory cards are good for documents, but be careful which files you store on them. For example, don't use your SD card for photo storage if you can avoid it: when you try to import photos from your camera's SD card using your laptop's reader, where would you copy the file to?





**ABOVE:** M.2 drives are replaced in a similar way to RAM, but you have to remove the retaining screw first



**ABOVE:** If your laptop has an SD card slot, you've already got a quick and easy way to add storage



**ABOVE:** A USB-C port gives you the option of connecting a huge number of peripherals, and even a way of getting power

## USB-C / Thunderbolt ports

If you have a modern PC with a USB Type-C port, you've already got a handy way of attaching accessories and power to your laptop with a single adaptor. Buy the Kingston C-HUBC1-SR-EN Nucleum (around £40), for example, and with a single cable plugged into your computer, you can get HDMI out, additional USB ports (say, for external storage, keyboard and mouse), a card reader and power into your laptop. That's a great way of providing more power, and means you can just dock when you need to, and unplug and carry your laptop when you go on the move.


**RIGHT:** External GPU housing is expensive, but it gives you desktop graphics performance

You can also get more advanced - and obviously more expensive - docks with additional ports if you need them.

Thunderbolt 3 uses the same connector as USB-C, but it will have a lightning symbol

next to it. Thunderbolt 3 is four times faster than USB-C (up to 40Gbit/s). This extra bandwidth means you can have faster external storage, and compatible docks give you more outputs, such as dual 4K options. This gives you more flexibility.

For some laptops, you can buy external graphics cards, too.

These are boxes that house a full-size GPU, connected to your laptop via Thunderbolt 3. These are expensive, however, and some only work with one brand of laptop. The Razer Core X should work with all Thunderbolt 3 systems, provided they're running Windows 10 RS1 or later. This model costs £310, but you then have to buy a graphics card and an external monitor, too. Still, this will turn any Thunderbolt 3-equipped laptop into a gaming powerhouse. 





# HOW TO BE A HIGH STREET HERO

Coronavirus is taking a terrible toll on our high streets, but small businesses are fighting back, as **Madeline Bennett** found when she spoke to a *Shopper* reader who runs a PC services firm

**F**ollowing on from our guides on selling online and taking payments, we talked to *Computer Shopper* reader and small business owner Kevin Bricknall. Bricknall has successfully established and expanded his PC services company during the pandemic to support local people with all their computing and smart home needs.

## What prompted the move to set up this new business?

2020 has been a challenging year so far for many reasons. Though we have been going since 2001, up until February this year we had been part of the family business, which was not related to computers (building contractors, in fact, who had been trading for 50 years), operating as a subsidiary.

However my father, who owned the building business, decided to retire in February. It was very fortunate that this happened just before the current Covid-19 situation as that could have complicated matters. So Bricknall's PC Services was separated into a separate limited company.

## How quick was it to get up and running?

It took four months to sort out a new office location, which is situated in the heart of Stony Stratford, part of Milton Keynes. My new office is just 50 metres from my house, which cuts down travelling time.

As well as Bricknall's PC Services Ltd ([www.bricknalls-pc-services.co.uk](http://www.bricknalls-pc-services.co.uk)), we have operated The Gadget Guru for a number of years locally, helping people with everything from smartphones to smart lighting. We also carry out website design under the Bricknall's Web Design Services name, and back in 2016, one of the websites we designed won Outstanding Website of the Year at the National Car Club Awards.

## What type of customers do you work with?

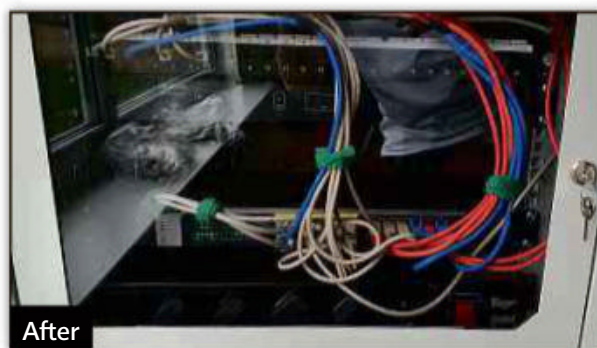
We deal with small to medium-sized companies as well as private individuals. Here are some examples of the customers we have helped in the last few months.

The picture (top left) is of a cable cabinet at a client's office, which had this mess of cables in the box and four – yes, four – switch boxes. This was soon tied up to have just the one switch box in it and a lot of shorter cables.

For another customer, we were called in to investigate problems they were having with their PC. What we found in this PC was rather shocking, and I told the client they were lucky nothing had caught light.



Before



After

↑ The firm sorted out a rat's nest of cables

The client told us that the machine was unstable and kept crashing. Upon taking the case cover off, the image (top right) shows what we found. We can only assume this was packaging that was left in the machine by the company that sold the desktop, as when they were shown this they had no idea it was there.

The image below that one is the machine restored to its original glory.

## Are you looking to expand into other areas than PC services?

We have identified a need for smart home services in Milton Keynes and the surrounding areas. There are lots of places that will sell you the equipment, but not many that will come out and install it for you or even have a smart home demonstration room (pictured right).

We have started to set up one of these in our new office. We have not currently had any visitors as we are still setting it up, and also need to work out the best way of accepting visitors under the current Covid-19 situation.



Before



After

↑ From fire hazard (top) to well-cooled machine

The idea is that people can view items in a setting that is very much like a home, and then purchase the equipment from ourselves and we come out and set it up. In the past few weeks, we have had a run on wireless security cameras and doorbells.

## Have you found new ways to use the web to get more business?

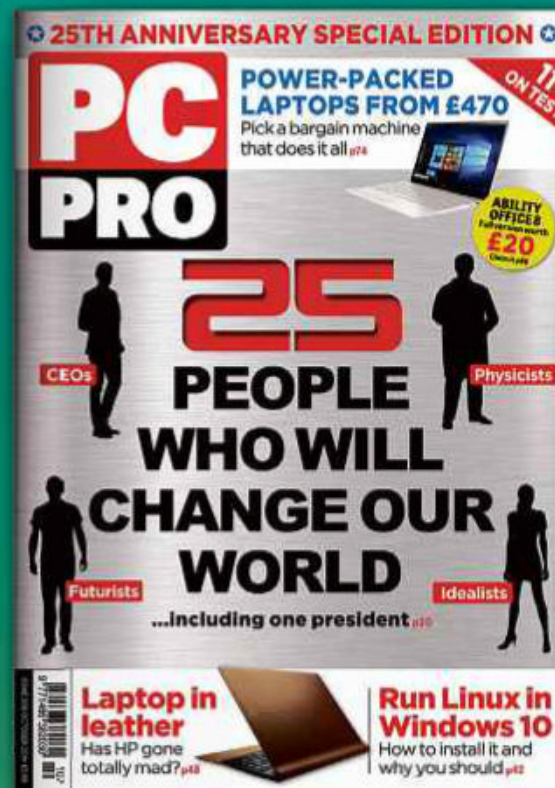
We have in the last week just set up an eBay shop. We're very new to doing that. **CS**



↑ The smart home demonstration room



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# Zygote

Tech firms and governments the world over are collecting personal data like there's no tomorrow, yet they still can't work out when a six-year-old's buying a car

## SIX APPEAL

Ario Faraji from Wallsend in North Tyneside sat down with the family laptop and logged into eBay. He knew what he wanted, and successfully bid for the customised Land Rover he was determined to own. But then things went horribly wrong and now Ario Faraji is being chased by debt collectors. Payment for the vehicle was taken using a PayPal account, and there was no cooling-off period. In the past, the account had been used for multiple purchases, but they were for small sums only and rarely exceeded £20. The second-hand Land Rover cost a hefty £19,000, but PayPal didn't question this unusual transaction or ask for any verification. Ario Faraji is six years old.

## TREASURE ILAND

Garett McGowan is a software programmer with a fondness for the veteran broadcaster and national treasure who is Sir David Attenborough. And Zygote cannot blame him. In fact, McGowan is so fond of the great man that he has created an Attenborough voice-bot, and trained it to read out Reddit comments in the much-loved tones of the famous naturalist.

He trained the artificial intelligence module using audio samples from TV documentaries and YouTube clips, and the results are quite startling. Zygote was particularly startled when Attenborough's famous voice started to discuss a relationship with a young male lover in great detail, along with various sexual achievements and the confession that his parents are not very nice to him. Sir David is 94 years old.

## CURRY FAVOUR

Indian prime minister Narendra Modi marked Independence Day by pledging to connect all of the 600,000 villages in the sub-continent to the nation's fibre optic network. The codename for this ambitious project is Digital

India, and the timetable for completion is 1,000 days.

The most ambitious element of the pledge is the fact that all the infrastructure and technical components for the system will be self-sufficient in terms of development, manufacture and installation, and there will be no reliance on foreign suppliers at all. Zygote applauds this ambition, but would like to point out that every Indian in every age category is to be tagged by a digital health ID containing a huge amount of personal data, and that a new Indian cyber-security authority is being set up to harvest it.

Coincidentally, this means the whole nation will be wired and tagged in time for the next national election, and it comes as no surprise that Prime Minister Modi has ambitions to be elected for an unprecedented third term.

## JOURNEY SEND

As the world gears up for the driverless-car revolution, Toyota has announced it's expanding its collaboration with Amazon Web Services so its cars can keep tabs on their drivers and snitch on them. This means insurance premiums will be directly related to data-based behaviour and the cars will be able to call for help automatically if they are involved in an accident, emergency or breakdown situation. The fact

that every step of every journey will be recorded and the data harvested has serious privacy implications, but hey, your phone already does that anyway.

Zygote is surprised it's taken Toyota and Amazon so long to catch up with our very own British alternative By Miles, which even though it won Best Car Insurance Provider two years running, few people have heard of. Simply fire up the By Miles app, plug the matchbox-sized Miles Tracker into the diagnostic port of any modern car, and the better you drive, the cheaper your car insurance – a whole lot cheaper.

## OFF YOUR FACE

Clearview is a facial-recognition system used by the Canadian Law Enforcement Sex Crimes Unit to identify offenders and their victims. The system runs on a massive photographic database that scrapes images from billions of social media profiles, which may or may not be a good thing.

Meanwhile, over the border in the USA, the Clearview corporation is being sued in multiple class-action lawsuits for violations of privacy. It has just hired Floyd Abrams for their defence, and he is the top expert in US constitutional law. His argument is crystal clear, and he maintains that there is simply no case to answer. He argues that

when people willingly post their mugshots on social media it immediately becomes public information. Revoking access to public information violates the First Amendment of the US Constitution, which protects the rights to free speech, expression and information. No further evidence, your honour.

## COCK A LEAKY

"CREST is an international, not-for-profit, accreditation and certification body that represents and supports the technical information security market."

At least, that's what it says on its website. Back in the real world, CREST suspended all of its accreditation procedures after an alleged technical information security breach. The allegation involves leaked exam documents for candidates hoping to head up testing and penetration teams for government systems that are coordinated under the UK National Cyber Security Centre.

And now Zygote hears word of a cache of CREST documents hosted on Dropbox appearing all over social media and containing detailed exam information and emails to and from senior personnel inside the National Cyber Security Centre. As Shakespeare said, once more unto the breach, dear friends, once more. ☞





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