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STEP-BY-STEP

AMD vs

Sam and Zak go head-to-head in an epic integrated graphics PC build-off

PC GAMING, right now, is at a standstill. The computing world has been rocked twice—once by the pandemic, and then again by cryptocurrency. Our humble GPUs have been snapped up and thrown into the deep, dark abyss of crypto mining, toiling away on inane calculations generating value from nothing. Whatever your stance on cryptocurrency, whether you believe it's the future of decentralized finance or a meritless environmental disaster, it's impossible to deny the impact it has had on the industry. As the availability of new GPUs has dwindled, enjoying

AMD INGREDIENTS

PART		STREET PRICE
CPU	AMD Ryzen 7 5700G	$359
Cooler	AMD Wraith Stealth Cooler	$0
Motherboard	Asus TUF Gaming B550M-Plus (WiFi)	$162
Memory	16GB (2x8GB) Crucial Ballistix @ 3600 CL16	$82
Storage	1TB Western Digital Black SN750 PCIe 3.0 M.2 SSD	$126
Power Supply	450W Corsair CV450 80+ Bronze	$45
Case	Phanteks Eclipse P400A	$75
TOTAL		**$849**

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INTEL

our humble pastime is all but impossible. This generation's mid-range graphics cards are now priced like last year's flagships. Budget options are coming in at $400, and the whole market, although slowly recovering after multiple government crackdowns, is still a place of desolation when it comes to sourcing that most vital of PC components.

So where do you turn, when the GPU's time in the sun is currently stifled? To integrated graphics? Given that processors are currently one of the few areas cryptocurrency can't make a quick buck, it's not a bad shout. For years, we've championed integrated graphics as "just enough" for entry-level 1080p gaming, but as GPUs became more affordable, development in iGPUs stagnated, until now.

With AMD launching its Ryzen G series chips, and Intel declaring its 11th-generation processors packed some of the best graphics performance Team Blue has ever mustered, we decided it was time to put the two to the test by building two similar rigs to truly decide who holds the crown of this generation's iGPU king.

INTEL INGREDIENTS

PART		STREET PRICE
CPU	Intel Core i5-11600K	$270
Cooler	be quiet! Dark Rock TF 2	$94
Motherboard	MSI MAG B560M Mortar WiFi	$160
Memory	16GB (2x8GB) Corsair Vengeance LPX @ 3200 CL16	$74
Storage	1TB Western Digital Black SN850 PCIe 4.0 M.2 SSD	$180
Power Supply	500W be quiet! System Power 9 CM 80+ Bronze	$85
Case	Corsair iCUE 220T RGB Airflow	$115
TOTAL		**$978**

AMD INGREDIENTS

AMD WRAITH STEALTH COOLER $0

There's nothing we love more than a good deal at *Maximum PC*, and a free cooler is right up our street for this build, especially given the price of the Ryzen 7 5700G.

As standard, it comes with the impressively robust Wraith Stealth cooler. This meaty offering packs a serious punch and makes Intel's old and outdated included heatsink look like a paperweight in comparison.

You install this little guy by removing the brackets from the motherboard and using the included mobo backplate to screw it into position. It's not quite as fancy as the be quiet! cooler offered up by the Intel rig below, but it's free! **www.amd.com**

AMD RYZEN 7 5700G $359

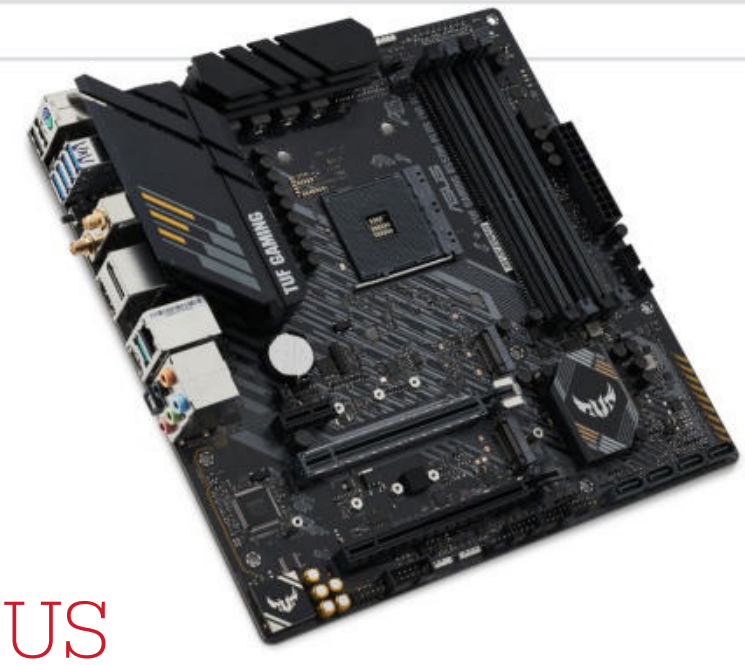
The main talking point of this build is the AMD integrated graphics chip, specifically the AMD Ryzen 7 5700G CPU. This chip marks the arrival of the 7nm Cezanne Zen 3 APUs.

This 65W CPU is packed with eight cores and 16 threads, a 3.8GHz base and a 4.6GHz boost clock, 16MB of L3 cache, and eight Radeon RX Vega CUs that operate at 2.0GHz. It looks pretty tasty on paper, it's a Zen3 chip too so it steps up to a DDR4-3200 interface from DDR4-2933. This will certainly aid gaming performance with the integrated 7nm Radeon RX Vega graphics engine. It should produce solid 1080p gaming and for our battle, that's exactly what we are aiming for. **www.amd.com**

450W CORSAIR CV450 80+ BRONZE $45

We have gone for a budget-priced PSU in this build, which is more than capable of powering our machine. With no traditional radiator AIO and no GPUs, we don't necessarily need a huge powerhouse PSU. It's a non modular power supply, which does hinder cable management a bit. Ideally you want to remove cables you're not using (such as any PCIe power and of course those excess SATA cables that are going to take up space in the bottom half of the case).

Another downside is if a cable gets damaged, replacing it may be a pain in the backside. Sure, the 80+ bronze efficiency rating isn't what we would have in a more premium build, but at such a budget price tag, we can't complain. **www.corsair.com**



ASUS TUF GAMING B550M-PLUS (WI-FI) $162

There are plenty of motherboards to choose from, but ASUS boards have worked well for us before and this TUF GAMING B550M-PLUS Micro-ATX is a solid pick. It has upgraded power delivery and comprehensive cooling options to fuel the latest AMD Ryzen CPUs. With BIOS FLBK support, it is easy to set up and install too.

The socket for this board is the AMD AM4 socket, making it ready for 3rd Gen AMD Ryzen processors and 3rd Gen AMD Ryzen with Radeon graphics processors. It also has next-gen connectivity with PCIe 4.0 M.2, USB 3.2 Gen 2 Type-A, Type-C, and WiFi 6 support. This should go well with our AMD Ryzen 7 5700G. **www.asus.com**

1TB WESTERN DIGITAL BLACK SN750 PCIE 3.0 M.2 SSD $126

This Western Digital SN750 is a sleek SSD with a design that accommodates most PC builds and the heatsink fits in nicely with our mobo. It should cut game load times, improve overall performance and allow for a solid 1080p experience. It doubles storage density from the last generation with NAND technology.

The SSD also is great when using the WD_BLACK SSD Dashboard, as it allows you to optimize performance with the gaming mode. It disables low power mode on the SSD and makes sure it is running at full power. With sequential read speeds of 3470MB/s and sequential write speeds of 3000MB/s, it's no slouch. **www.westerndigital.com**

16GB (2X8GB) CRUCIAL BALLISTIX @ 3600 CL16 $82

There is always an abundance of RAM sticks to choose from when building a PC. RAM speed was our main priority, as this matters more for AMD CPUs than Intel chips. AMD CPUs have a cut-off speed of 3733MHz, so ideally we would have had some of those in this build. However, these Crucial Ballistix DDR4 sticks run @3600MHz. 16GB is a good amount, but this can always be increased, the price swayed us—under $100 is good for sticks of this speed. It isn't the most interesting choice, but we weren't going for a specific aesthetic. RGB is always an option, but if you want to tone things down a little, this all-black Crucial Ballistix memory kit is a good choice. **www.crucial.com**

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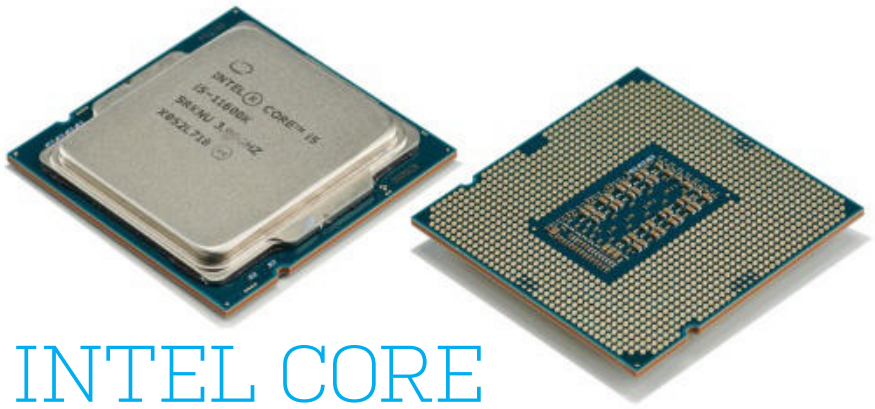
PHANTEKS ECLIPSE P400A $75

This all-black ATX mid-tower case from Phanteks is a great choice for this build and a majority of other builds too. With an angular mesh front panel, the case looks sharp and strong with plenty of intake airflow. The front I/O contains two USB 3.0 ports, a mic and headphone jack, a reset button, and a three-speed fan controller. With the great airflow and fan controller built-in, you can tell this case has been made with airflow in mind.

It comes with two 120mm fans with enough room for six 120mm fans if you need them or you want your PC to take off. It supports ATX, Micro-ATX, Mini-ITX, and E-ATX so it's pretty darn compatible. Paired with some great cable management, there's not much we can say that is wrong with this case. **www.phanteks.com**

INTEL INGREDIENTS



INTEL CORE I5-11600K $270

A Maximum PC regular, the Core i5-11600K is perhaps the best of Intel's latest generation of processors. Featuring six cores, 12 threads, 12MB of cache, and a turbo clock speed of up to 4.9GHz, it's a 95W 14nm monster based on the Rocket Lake architecture.

Other headline features include PCIe 4.0, but we're most interested in the integrated graphics. The 11600K delivers Intel's latest UHD Graphics 750 config, with a max dynamic frequency of 1.3GHz, 32 Execution units, and the ability to drive displays up to 5120x3200 @ 60 Hz. It also has support for DirectX 12, OpenGL 4.5, and a number of interwoven Intel GPU features too. But is it enough to beat the competition? www.intel.com

BE QUIET! DARK ROCK TF 2 $94

Unlike our competition over on Team AMD, the Core i5-11600K doesn't come with its own cooler. So, we've teamed up with be quiet! to bring its latest Dark Rock TF 2 to bear on the plucky hex-core chip. With a super sleek design, twin fan construction, and epic six heat-pipe design, this twin pseudo-low-profile CPU cooler can chill any chip capable of running at near 230W of TDP, and at an impressively quiet 27.1dB(A).

Each manufacturer measures TDP differently, but this thing is more than capable of cooling even the Core i9-11900K. It also packs in a three-year warranty, and the fans even have a rated lifespan of 300,000 hours at 25C. www.bequiet.com

MSI MAG B560M MORTAR WIFI $160

Magnificent? Magnum? Magnetic? MSI hasn't told us what "MAG" stands for in its latest line of motherboards, but this is the board that we picked to house our plucky little chip.

Complete with a sleek aesthetic and plenty of connectivity, the B560M Mortar comes highly recommended, and packs in exactly what we need, including a PCIe 4.0 slot for our M.2 of choice, a ton of onboard connectivity, including WiFi 6E and a 2.5G LAN port, and lastly both an HDMI and DisplayPort to go with that integrated GPU. On top of that, we can pop a GPU (when they're available) in the topmost PCIe slot and take advantage of that PCIe 4.0 x16 connectivity as well.

For a B series board at $160, this thing is rammed with future-proofed goodness. www.msi.com

500W BE QUIET! SYSTEM POWER 9 CM 80+ $85

We'll say this until we're blue in the face but get a decent power supply. You don't have to spend a lot, just buy from a brand you trust, even if it has an 80+ rating, and is non-modular. There are so many dodgy PSUs with subpar components out there that could take your system out, it's not worth the risk.

Take our faulty RGB controller tripping the entire build. It shot the power supply instantly, but the rest of the rig, the motherboard, the CPU, were all fine—protected by some ingenious engineering from this German manufacturer.

The System Power 9 CM is a fine little unit, with plenty of cables, and modular too. At 500W, it's got plenty of headroom for our system, and will even support an RTX 3080 (if they're ever in stock again). Oh, and it's... quiet. www.bequiet.com

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STEP-BY-STEP

1TB WESTERN DIGITAL BLACK SN850 PCIE 4.0 M.2 SSD $180

So as we said earlier, our plucky little Core i5, supports PCIe 4.0 where the Ryzen 7 5700G does not. Advantage Intel. And we're going to take advantage of that advantage with this speedy little number from Western Digital. A counterpart to the SN750 featured in the AMD build above, the SN850 packs in 1TB of high-speed PCIe 4.0 NAND Flash goodness for just under $180.

Performance is better than you'll see in its predecessor PCIe 3.0 part. We're talking sequential read speeds of 7,000 MB/s and writes at 5,300 MB/s. For IOPS? 1 million 4KB Random Read and 720K Random Write—even the failure rate is impressive at 1.75M hours of use. What's not to love? **www.westerndigital.com**

16GB (2X8GB) CORSAIR VENGEANCE LPX @ 3200 CL16 $74

So, the motherboard supports up to 5,066 MT/s memory, but let's be real, that stuff is still crazy expensive, and unless you're editing 8K video with a Core i9 (which, let's face it, you wouldn't be doing on a B550 board anyway), you won't need it.

In fact, even looking at a 5000 MHz kit of Corsair Vengeance LPX makes us cry, seriously. $1,075 from Corsair, for 16GB of 5,000 memory with a CAS latency of 18. So, the speed is impressive, and the latency epic, but not at that price. 16GB at 3200 will be more than enough for everything we need here, and better yet, the low-profile element of these bad boys gives us plenty of clearance for the cooler too **www.corsair.com**

CORSAIR ICUE 220T RGB AIRFLOW $115

Last but by no means least, we have our case for this build, and that's the trusty Corsair iCUE 220T RGB Airflow. Now, it's getting a little long in the tooth at this stage, but as Corsair doesn't have a budget successor for it just yet, it's still perhaps one of the best (sort of) budget cases you can buy.

Perhaps unsurprisingly, the airflow with this chassis is impeccable. Even better than the Phanteks Eclipse P400A above. The reason behind it (aside from the triple fans), is that Corsair has expertly designed the front of the case with these triangular boomerang cutouts, instead of applying a mesh filter over the top. Contrary to popular belief, mesh filters actually impede airflow compared with a proper cutout. They create turbulence, and make it difficult for a fan to draw air through. Cutout panels like this one provide far larger gaps for that air to be drawn through, meaning lower temperatures inside your rig.

Aside from that, it comes with a set of three RGB 120mm fans as standard, and plenty of mod cons to make your building experience pretty seamless. And it's available in black or white finishes. The only downside? We wish it had a fan controller as well as an RGB controller. **www.corsair.com**

CHOOSING BENCHMARKS

The world of integrated GPUs isn't cut out for our usual suite of tests

FOR MOST OF OUR TESTING, we typically have a set list of benchmarks designed around being run on systems with dedicated GPUs. Most of the time, that involves running X game at Y resolution—usually on the highest graphical settings profile the game comes with as default. That way, it makes it easy for you at home to replicate those same tests with your own machine. It also gives you a better idea of how your rig scores in comparison and, of course, gives us a level playing field to work with when it comes to carrying out any similar testing in the future.

The problem with that is, in the world of integrated graphics, those kinds of benchmarks are grossly unfair to small integrated GPUs, such as the ones featured in these two builds. Yes, integrated graphics have come a long way over the years, and they are far from being stuck operating as media PCs and home office machines today, but throwing *Total War: Warhammer II* at an iGPU at 1080p Ultra is just cruel. Nor will it give us an accurate representation of how this chip would perform under more reasonable and realistic circumstances.

Total War is perhaps the best example of a CPU-intensive title from our testing suite. It's a game we choose specifically because it stresses the processor during regular benchmarking. In fact, most games (particularly single-player titles) generally leverage most, if not all, of the stress onto the GPU, rather than the CPU, or both. Strategy games, however, with their many thousands of individual units, and some online games too, really do push processors hard.

Ultimately, you can have all the high-speed memory in the world, but it's just not going to be enough to manage *Total War* at 1080p Ultra on an iGPU, no matter what. And that's often reciprocated in our benchmark figures for builds like this. It's not unusual to see scores of 5 or 6fps in these tests on our usual platform and, obviously, that won't do.

So, for this feature, we have decided to shake things up and do something a little different with the benchmarks. This time, we're going to be testing a selection of games at 1080p specifically, but across three separate presets instead, Low, Medium, and High, no Ultra in sight. The games are still challenging, and still comparable to the ones we regularly use in our usual suite, but it should give us a better indication of what you can expect from your iGPU PC. But we're not stopping there either! Oh no.

GAMING PERFORMANCE

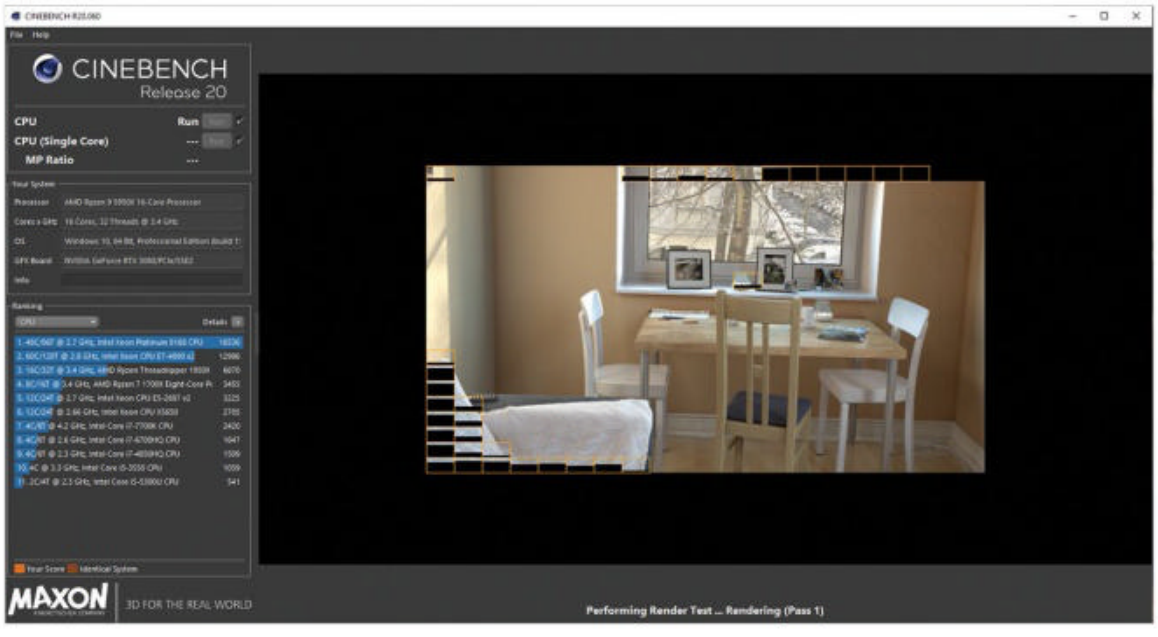
First up on the chopping block are the game benchies. In this case, we're going to be testing *Total War: Warhammer II*, *Middle Earth: Shadow of War*, and *Assassins Creed: Valhalla* (all the colons) at 1080p low, medium, and high presets.

This gives us a nice mix of titles to draw upon, including an older, neutral AAA game from 2017, in the form of *Shadow of War*, a brand new AMD-optimized AAA title in *Valhalla*, and an Intel optimized strategy game in the shape of *Total War*. All with included easy-to-run benchmarks.

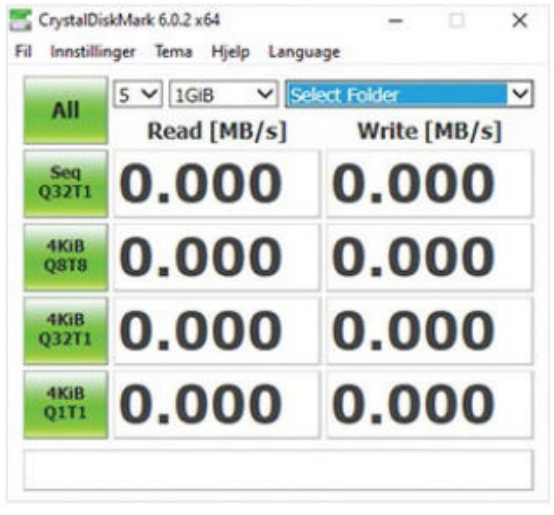
On top of that, we're also going to be performing some more "old-school" synthetic tests, namely 3DMark's Fire Strike and Time Spy tests at 1080p. These will provide us with an index we can refer to, to see how far we've come from generation to generation, and also let us test performance both with DX11 (Fire Strike) and DX12 (Time Spy).

COMPUTATIONAL PERFORMANCE

With gaming out of the way, it's also important we take a quick look at the synthetic computational element of these two builds too. Both offer vastly different architectures and performance figures because of it. To do this, we've grabbed



CineBench is a staple rendering test that pushes your processor to the limit.



CrystalDisk shows how our SSDs perform

The difference between Low and High settings in *Total War* is staggering

some basic, easy-to-run, synthetic tests that you can use yourself at home.

For processing performance, we'll be using CineBench R20 (you can download it yourself for free from here: bit.ly/Cine20MPC) to test out our processor performance, taking advantage of both its single-core and multi-core metrics.

And finally, to test out our SSD performance, we'll also be taking a quick look at CrystalDiskMark 6 (bit.ly/CD6MPC). This should give us an accurate representation of how our two SSDs perform under pressure, namely looking at Sequential read/write speeds at a queue depth of 32, 1 thread, and also Random 4K read/write speeds at a queue depth of 1, 1 thread.

Sequential performance is indicative of reading or writing files that are stored close to one another on the drive itself (for instance, your photographs, videos, and media files, things like that), whereas Random 4K testing is more indicative of something like a game reading and writing to a variety of different locations on the drive at any one time. This is almost always more difficult to do than with sequential data, thus the far lower numbers in the tests.

As neither of these systems was really cut out to be video-rendering machines, workstations, or anything of the like, due to a lack of dedicated GPU, which massively accelerates these workloads, we're going to skip out on any memory testing or power-draw this time around.

So, ultimately, what we're left with is purely an exercise to see which integrated graphics solution is superior to the other.

FUTURE PROOFING PICKS

So, you've seen our two builds, looked at the parts, and wondered about the future. After all, investing in a rig like this is usually going to future-proof you for the next five years, and with both AMD and Nvidia expecting silicon shortages to end from mid-2022, the chance of getting a graphics card at a reasonable price doesn't seem far away.

So, what happens if you add a GPU to either of these two systems? Traditionally, AMD's Ryzen G processors used to feature a reduced number of PCIe lanes for graphics. In fact, with the 3000 G series, it was half that of what you'd find on the non-APU equivalent or Intel's chips (x8 not x16 lanes). That meant most GPUs would be bottlenecked by a lack of bandwidth as the lanes just weren't there. x8 PCIe 3.0 lanes equates to around 8GB/s (or 64Gb/s or 4GT/s whatever takes your fancy) of maximum bandwidth, whereas x16 doubles that figure leading to a max of 16GB/s. The latest generation, PCIe 4.0, doubles those figures again, so you end up with a max bandwidth of 32GB/s across a x16 slot port, and so forth.

Now, we have yet to saturate the PCIe 3.0 x16 slot, 16GB/s is more than enough bandwidth to facilitate even the most high-end graphics card. That said, x8 lanes isn't, and you typically end up with a reduction in frame rate of between 5-20%. Fortunately, AMD has redesigned its latest APUs to include x16 graphics PCIe lane support. It's still PCIe 3.0, but if you add a full-sized GPU, you shouldn't see any performance degradation, unlike what we saw back with the 3000 series. Good stuff.

The only concern is what AMD and Nvidia produce in terms of their next-gen GPUs, and how large the performance delta will be compared with the previous generation. We expect to see both the RTX 4000 series and RX 7000 series cards launch next year. AMD will likely have packed some dedicated hardware in for ray-tracing and Nvidia will be going harder than ever, due to the increased competition from the RX 6000 series.

It could be the year that we finally eke over that 16GB/s PCIe 3.0 x16 lane bandwidth limit, at which performance may begin to drop with our AMD Ryzen 7 5700G series processors (along with every other PCIe 3.0 chip, including Intel's 10 series parts too).

These things are hard to predict, and the performance difference may be less than 10% so it's a fairly negligible worry, but it's worth considering if you plan to invest in a GPU later on.

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AMD CONCLUSION

OH BOY, did we get some results in this test. It wasn't necessarily what we had hoped for, but this is a test of the integrated graphics on each side of the battle, AMD and Intel. In an ideal world, we would accompany these CPUs with some hefty GPUs that would improve performance, but it's a test of iGPUs, not discrete GPUs.

On the AMD side of the head-to-head, the build itself was plain sailing to piece it all together, and yet the opposite once we tried to boot things up for the first time. With nothing but a blank display, we updated the BIOS (which was fairly easy as our ASUS mobo has a BIOS FLBK port on its I/O) and then used a USB Windows 10 installer to get it ready for testing.

Once the machine powered on, we then installed the relevant drivers for the motherboard and the chipset to get the AMD APU up and running properly, or so we thought. After some initial testing, our results weren't what we expected. Taking a peek at the memory using CPU-Z, it was clear the DDR4 was running at 2,666MT/s, not the 3,600 it's specced at. Jumping into the BIOS, we realized we'd forgotten to enable the XMP profile, so the speed and timings were out (rookie error!). To do that, we set the Ai Overclock Tuner profile to the DOCP option. This is AMD's alternative to XMP (eXtreme Memory Profile) usually found on Intel motherboards.

For AMD, with Asus motherboards, it's located inside of the Ai Tweaker menu. This should enable the XMP settings found on the RAM (increasing timings, frequency, and voltage in the process) and tell the motherboard to use the full speed the kit is capable of running at. RAM frequency matters to AMD chips, and for our PC to work at its best, it needs the full 3,600 MT/s that our Crucial Ballistix RAM should be providing.

Unfortunately, after applying the DOCP profile, the machine kept rebooting and failing to post. So, we headed back to the BIOS and declocked the frequency down to 2,800 MT/s, to see if it would boot at a higher speed than the original stock settings outlined by JEDEC. Thankfully it did, but this was still an issue as we needed the memory speed to be working at its fastest. We kept restarting the PC and booting it up with a higher memory frequency each time to see what would stick but, unfortunately, the best we could get out of these sticks was 3,133 MT/s. It's not awful, but we didn't choose 3,600 MT/s sticks to underachieve like that, and these APUs love faster memory.

SYNTHETIC TESTS

	ZERO-POINT	
CineBench R20 Single (Index)	572	576 (1%)
CineBench R20 Multi (Index)	4,157	5,367 (29%)
CrystalDisk QD32 Sequential Read (MB/s)	6,983	3,265 (-53%)
CrystalDisk QD32 Sequential Write (MB/s)	5,175	2,952 (-43%)
CrystalDisk QD1 Random 4K Read (MB/s)	81	46 (-43%)
CrystalDisk QD1 Random 4K Write (MB/s)	247	150 (-39%)
3DMark: Fire Strike DX11 (Index)	2,098	3,835 (83%)
3DMark: Time Spy DX12 (Index)	792	1,547 (95%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

GAMING TESTS

	ZERO-POINT	
Total War Warhammer II @ Low	20	34 (70%)
Total War Warhammer II @ Medium	17	28 (65%)
Total War Warhammer II @ High	14	25 (79%)
Middle Earth: Shadow of War @ Low	15	28 (87%)
Middle Earth: Shadow of War @ Medium	13	24 (85%)
Middle Earth: Shadow of War @ High	9	17 (89%)
Assassins Creed: Valhalla @ Low	12	28 (133%)
Assassins Creed: Valhalla @ Medium	7	22 (214%)
Assassins Creed: Valhalla @ High	5	17 (240%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Average frame rates reported for games. All tests were performed at 1080p on the indicated graphics preset. Zero point consists of an Intel Core i5-11600K, 16GB of DDR4 @ 3200, and a 1TB WD SN850 M.2 PCIe 4.0 SSD.

The only other memory we had spare were some 3,200MT/s G.Skill Trident Zs. Out of curiosity, we looked at whether we could get more performance out of these. Again we could only get a stable boot when configured to 3,000MT/s, so Crucial's offering still works better here.

Results were lackluster compared with what we're used to seeing from a discrete GPU, of course, but that's to be expected. After getting around 30fps on low presets on some games, our hopes for smooth 60fps, 1080p gameplay were dashed. The benchmark results speak for themselves. Ideally, you don't want to settle for a low preset, but anything less than 30fps isn't acceptable by today's PC gaming standards. SSD read and write speeds, however, were a high point of this build and for normal day-to-day usage, so while it works pretty well as a daily driver, it's not so good if you intend to do any high-end gaming.

Lacking a GPU and RAM sticks that run at their full potential hold this machine back from achieving a smooth Full HD gaming experience. If we had sticks that were fully compatible with our motherboard, we may be looking at a different outcome (reports even suggest up to 10-15% additional performance).

Still, the results were much higher than our Intel competition, and in older games or less graphically intense titles, such as *Minecraft*, *Hades*, or *Roguelikes*, it's an ideal PC to get your foot in the door. It just depends on what you play. Mainstream games, yes. AAA titles, no. **–SL**

! PG. 71 STEP-BY-STEP

SYNTHETIC TESTS

	ZERO-POINT	
CineBench R20 Single (Index)	576	572 (-1%)
CineBench R20 Multi (Index)	5,367	4,157 (-23%)
CrystalDisk QD32 Sequential Read (MB/s)	3,265	6,983 (114%)
CrystalDisk QD32 Sequential Write (MB/s)	2,952	5,175 (75%)
CrystalDisk QD1 Random 4K Read (MB/s)	46	81 (76%)
CrystalDisk QD1 Random 4K Write (MB/s)	150	247 (65%)
3DMark: Fire Strike DX11 (Index)	3,835	2,098 (-45%)
3DMark: Time Spy DX12 (Index)	1,547	792 (-49%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

GAMING TESTS

	ZERO-POINT	
Total War Warhammer II @ Low	34	20 (-41%)
Total War Warhammer II @ Medium	28	17 (-39%)
Total War Warhammer II @ High	25	14 (-44%)
Middle Earth: Shadow of War @ Low	28	15 (-46%)
Middle Earth: Shadow of War @ Medium	24	13 (-46%)
Middle Earth: Shadow of War @ High	17	9 (-47%)
Assassins Creed: Valhalla @ Low	28	12 (-57%)
Assassins Creed: Valhalla @ Medium	22	7 (-68%)
Assassins Creed: Valhalla @ High	17	5 (-71%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Average frame rates reported for games. All tests were performed at 1080p on the indicated graphics preset. Zero point consists of an AMD Ryzen 7 5700G, 16GB of DDR4 @ 3133, and a 1TB WD SN750 M.2 PCIe 3.0 SSD.

INTEL CONCLUSION

WHAT A RIDE this whole build process has been! If you skip to page 68, you can read about how our Intel build went "pop" during the photo shoot, taking out a power supply. We don't know why, a fault somewhere along the line, maybe? But one fresh PSU later and we're good to go.

Fortunately, unlike our Team Red competition, the Intel build's install process went a lot smoother. As we don't technically rely on high-speed memory in anywhere near the same capacity, what you get with this build is exactly what you get. Theoretically, we could add higher-speed memory, maybe go for a 3600 or 3733MT/s kit, but the only area we'd see performance increases would be in video-editing applications and maybe in Adobe Photoshop or similar programs. It's not worth the extra investment unless you can find them cheaper due to greater availability (or a kit that doesn't come with some flashy RGB).

You'll notice I'm delaying talking about how the Intel rig did in terms of in-game performance. That's because, if we were to sum it up in two words, it'd be "not good". Not "not good" as in an "oh man, this system doesn't have a discrete GPU, how terrible is the performance at 1080p" sort of way, but in an "oh man, this system can't compete with AMD, despite costing more, and the performance is worse at 1080p" sort of way. Yeah, that kind of "not good".

Our highest recorded average frame rate was 20fps in *Total War*, on Low at 1080p. The lowest figure was in an admittedly AMD-optimized title, *Assassins Creed: Valhalla* with a whopping 5fps on High. That's not good. This is Intel's latest UHD 750 graphics and it doesn't hold a candle to that inside the Ryzen 7 5700G or even its cheaper sibling. This is a shame, because Intel's Iris stuff is genuinely impressive, certainly on laptops. Perhaps it's a limitation due to the size of the processor, or complexity due to architecture design (Intel still uses a monolithic chip design that's costly and difficult to develop), but the lack of Iris graphics makes AMD the go-to choice for those looking to build a budget gaming PC.

The story gets better when you play some less intensive titles, such as *Hades*, *Minecraft*, and *Crusader Kings III*. All of them performed well, averaging 30-40fps, making them more than playable, even *Divinity: Original Sin 2*, and *Prison Architect* were enjoyable experiences. So maybe it's not hitting that 60fps sweet spot, but you don't need to play AAA titles to have fun, and both of these machines represent a significant leap over past generations in terms of that capacity. That said, with either build, you'd almost always be better off getting a dedicated GPU if you could right now.

Apart from that, the big winner for Intel was in the PCIe 4.0 performance. WD's SN850 PCIe drive ran rings around its PCIe 3.0 predecessor, clocking in substantially higher scores, sequential reads were twice that of the SN750, and writes almost double, with a similar story on the Random 4K situation too.

So, then, AMD wins. For the time being, Intel can't quite keep up, even with an unlocked Core i5 and an advanced cooler on top of it. Admittedly, the 5700G is considerably more expensive than the i5, but even the 5600G clocks in similar performance (although with two fewer cores), and that's a processor that comes in at around $260, $10 cheaper than the Intel chip, and includes a cooler too.

If you want to run an iGPU system, don't care about AAA titles, and are happy with that PCIe 3.0 limitation, Team Red is rightly king of the hill. However, if you're looking for something to tide you over until you invest in a next-gen GPU, Intel still holds the iGPU candle there, at least for now. With both AMD and Intel ramping up to launch new processors, it may not be long until the battlefield shifts once more.

It's a tale as old as time, Blue vs Red, Intel vs AMD—no doubt this battlefield will be revisited again soon, and that's no bad thing, at least not for us. **–ZS**