

Лекція 2 (частина 1)

Апаратне забезпечення ПК (Hardware)

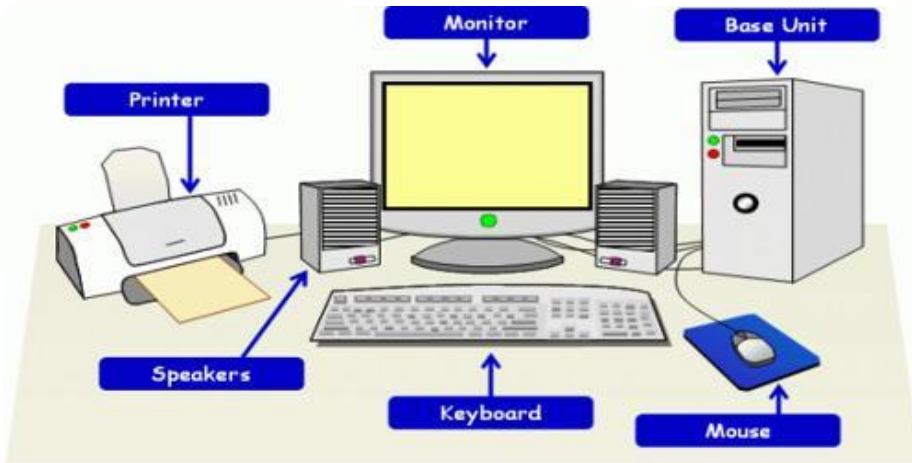


План лекції:

1. Структура персонального комп'ютера
2. Компоненти системного блоку
3. Організація охолодження системного блоку

Структура персонального комп'ютера

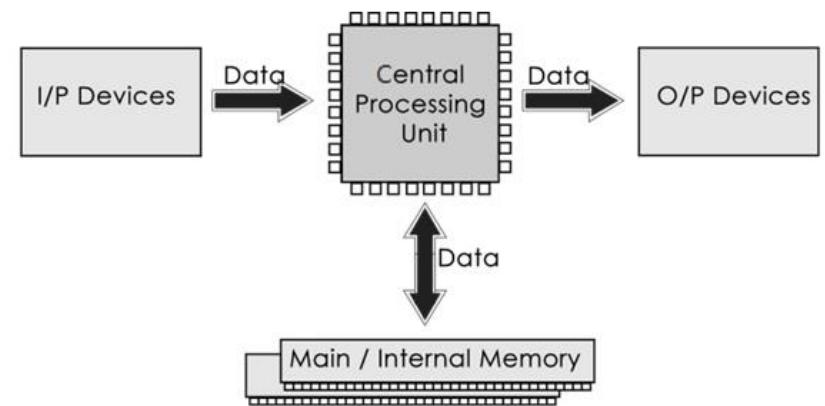
Зовнішній рівень



Інформація, що попадає в систему за допомогою пристроїв вводу, обробляється в системному блоці й передається на пристрої виводу.

Дані із зовнішніх пристроїв поступають в блок, що їх обробляє, по каналах передачі (шині). Обробка виконується процесором, при цьому використовується внутрішня пам'ять комп'ютера. Результат передається на зовнішні пристрої.

Внутрішній рівень



Компоненти системного блоку



- Корпус (case) з блоком живлення
- Материнська плата (Motherboard)
- Центральний процесор (CPU)
- Графічний процесор (GPU)
- Пам'ять (RAM)
- Накопичувачі (HDD, SSD, CD, DVD, HD-DVD, BD)
- Плати розширення (адаптери)

Корпус ПК



MINI-ITX Tower

Example: NZXT H210

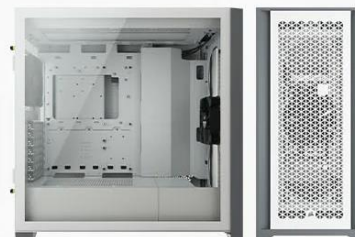
- mITX
- 349mm x 210mm x 372mm
- Expansion Slots: 2



MICRO-ATX Tower

Fractal Design Meshify C Mini

- mITX, m-ATX
- 399mm x 212mm x 395mm
- Expansion Slots: 5



MID Tower

CORSAIR 5000D

- mITX, m-ATX, ATX
- 520mm x 245mm x 520mm
- Expansion Slots:
7 Horizontal + 2 Vertical



Full Tower

Thermaltake A700 TG

- mITX, m-ATX, ATX, e-ATX, XL-ATX
- 582mm x 294mm x 596mm
- Expansion Slots: 8

	Full-Tower	Midi-Tower	Mini-Tower	Slim Desktop
Орієнтовна висота	550+ мм	До 500 мм	До 400 мм	До 400 мм
Форм-фактор материнських плат	E-ATX, ATX, mATX, mini-ITX	E-ATX, ATX, mATX, mini-ITX	mATX, mini-ITX	mATX, mini-ITX
Кількість слотів розширення	1-7	1-7	1-4	1-4
Форм-фактор блоку живлення	ATX	ATX	ATX, SFX	ATX, SFX
Рекомендована довжина кабеля 4+4 ATX PS 12V для живлення центрального процесора	від 550 мм	до 550 мм	до 500 мм	до 400 мм



Блок живлення (PSU)



ATX



SFX



TRX



FlexATX



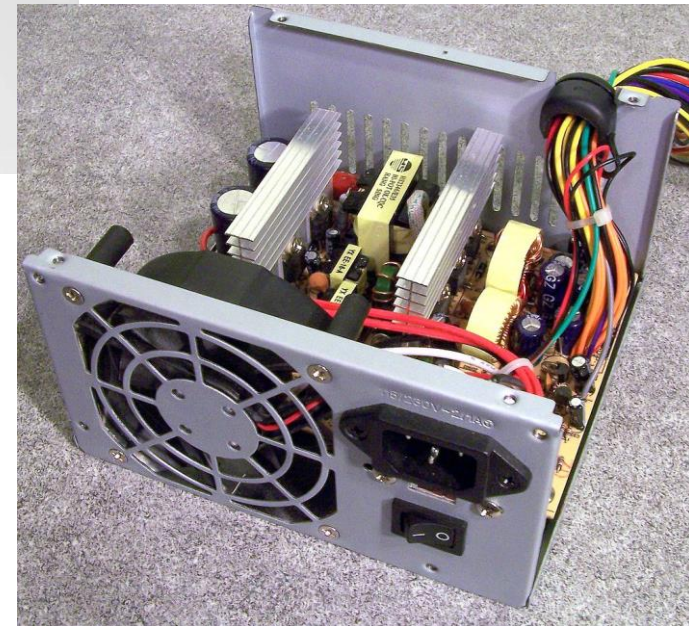
BTX



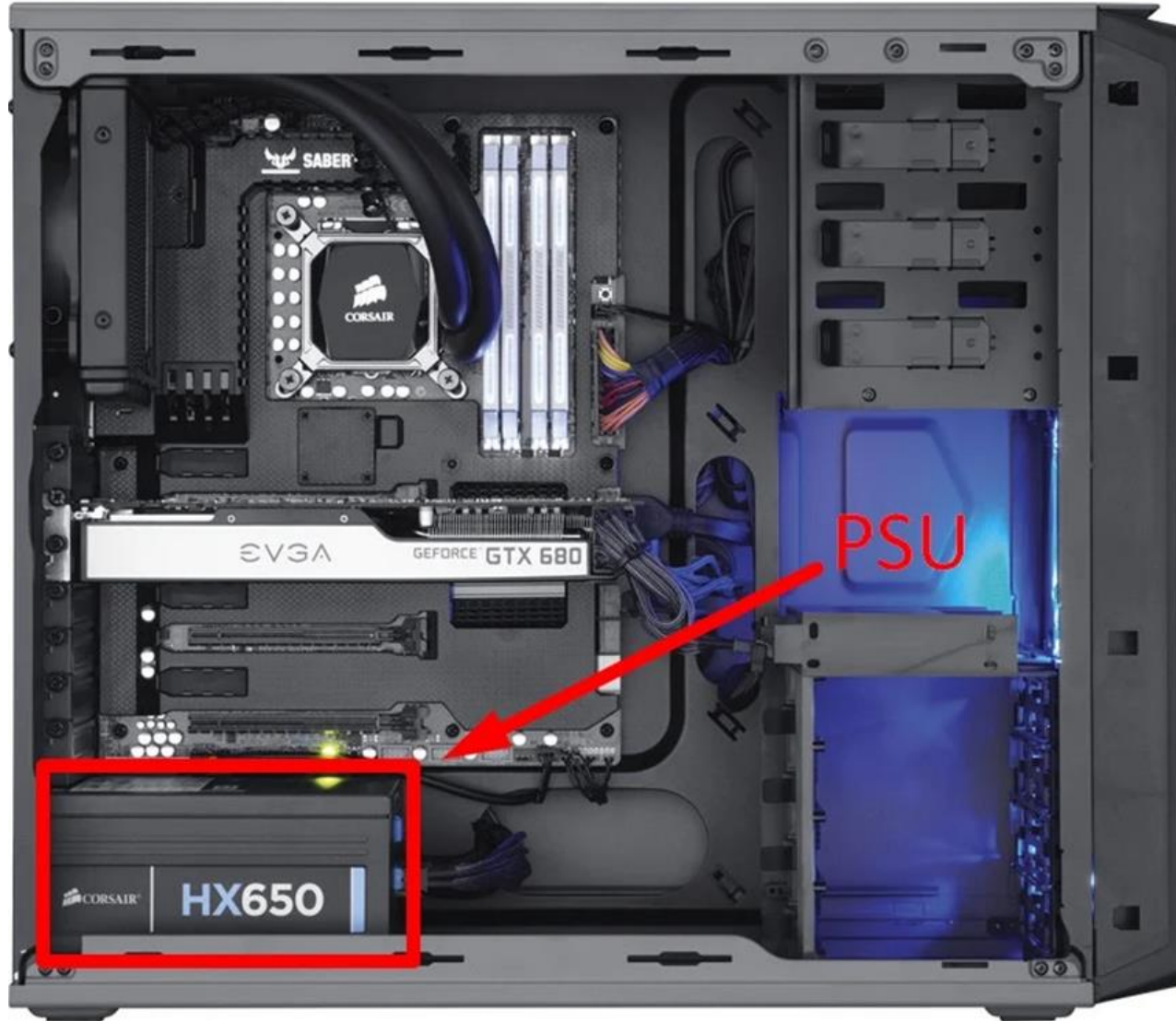
Визначення потужності БЖ!

PSU calculator

be quiet!



Блок живлення (PSU)



Конектори блоку живлення

AT power connector (on older, AT motherboards)

Color	Pin	Signal
Orange	P8.1	Power good
Red	P8.2	+5 V
Yellow	P8.3	+12 V
Blue	P8.4	-12 V
Black	P8.5	Ground
Black	P8.6	Ground
Black	P9.1	Ground
Black	P9.2	Ground
White	P9.3	-5 V
Red	P9.4	+5 V
Red	P9.5	+5 V
Red	P9.6	+5 V

24-pin ATX12V 2.x power supply connector

Color	Signal ^[A]	Pin ^[B]	Pin ^{[B][C]}	Signal ^[A]	Color
Orange	+3.3 V	1	13	+3.3 V	Orange
Orange	+3.3 V	2	14	+3.3 V sense ^[D]	Brown
Orange	+3.3 V	2	14	-12 V	Blue
Black	Ground	3	15	Ground	Black
Red	+5 V	4	16	Power on ^[E]	Green
Black	Ground	5	17	Ground	Black
Red	+5 V	6	18	Ground	Black
Black	Ground	7	19	Ground	Black
Grey	Power good ^[F]	8	20	Reserved ^[G]	None
Purple	+5 V standby	9	21	+5 V	Red
Yellow	+12 V	10	22	+5 V	Red
Yellow	+12 V	11	23	+5 V	Red
Orange	+3.3 V	12	24	Ground	Black

ATX12VO power supply connector

Color	Signal	Pin	Pin	Signal	Color
Green	PS_ON#	1	6	PWR_OK	Gray
Black	COM	2	7	+12 VSB	Purple
Black	COM	3	8	+12 V1 DC	Yellow
Black	COM	4	9	+12 V1 DC	Yellow
TBD	Reserved	5	10	+12 V1 DC Voltage Sensing Pin	Yellow

- A. ^{a b} Light-blue background denotes control signals.
- B. ^{a b} Light-green background denotes the pins present only in the 24-pin connector.
- C. ^a In the 20-pin connector, pins 13–22 are numbered 11–20 respectively.
- D. ^a Supplies +3.3 V power and also has a second low-current wire for remote sensing.^[46]
- E. ^a A control signal that is pulled up to +5 V by the PSU and must be driven low to turn on the PSU.
- F. ^a A control signal that is low when other outputs have not yet reached, or are about to leave, correct voltages.
- G. ^a Formerly -5 V (white wire), absent in modern power supplies; it was optional in ATX and ATX12V v1.2 and deleted since v1.3.

Конектори блоку живлення



Dual-standard divisible connectors commonly seen on modern PSUs (left to right): ATX/EPS motherboard power (20-pin/24-pin), ATX12V/EPS12V CPU power (four-pin/eight-pin), and supplemental PCIe eight-pin/six-pin (aka "6+2")



Ефективність блоків живлення



Standard



Bronze



Silver



Gold



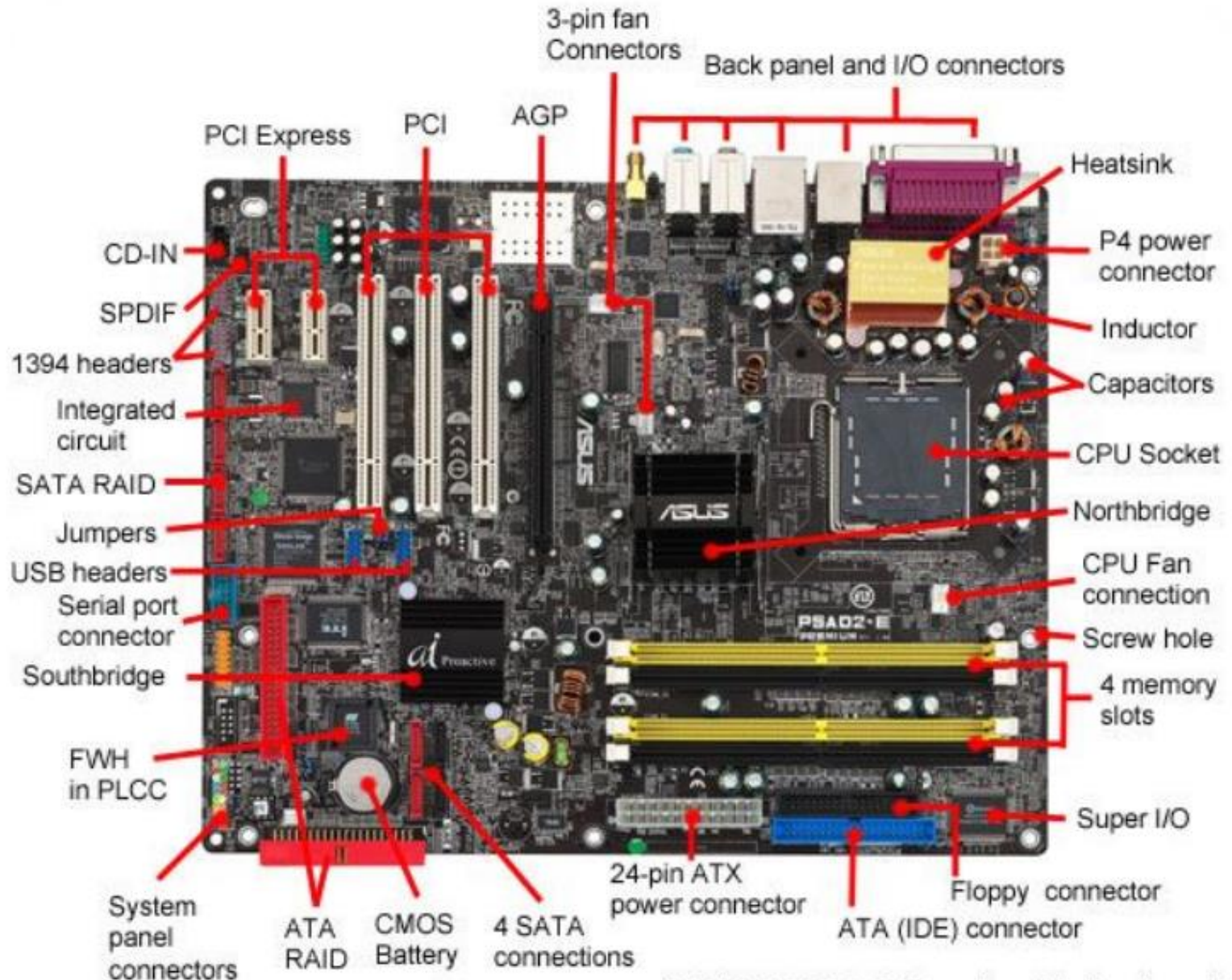
Platinum



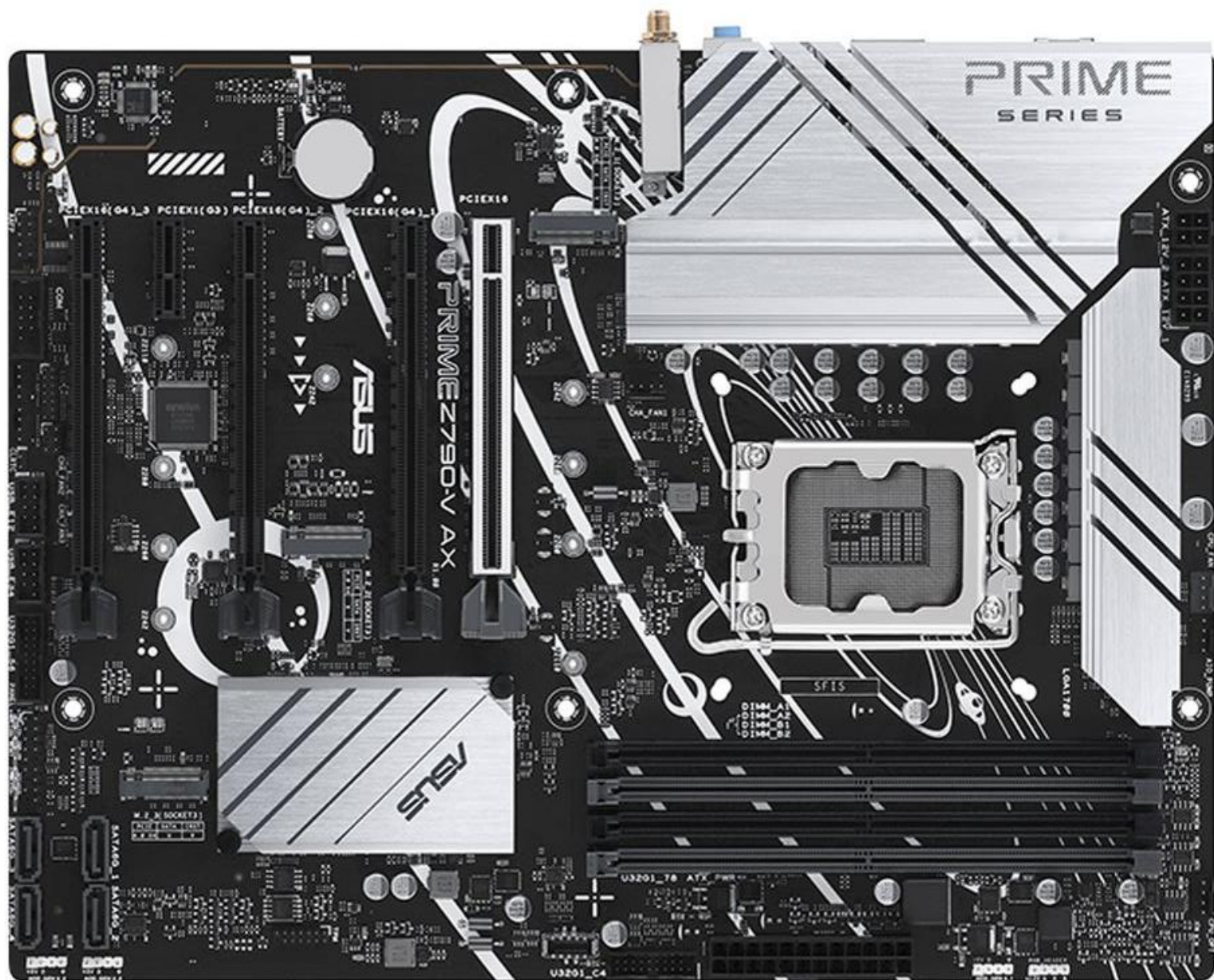
Titanium

80 PLUS Certification	230V EU Internal Non-Redundant				230V Internal Redundant				
	% of Rated Load	10%	20%	50%	100%	10%	20%	50%	100%
80 PLUS	-	82%	85% PFC \geq 0.90	82%	-	-	-	-	-
80 PLUS Bronze	-	85%	88% PFC \geq 0.90	85%	-	81%	85% PFC \geq 0.90	81%	81%
80 PLUS Silver	-	87%	90% PFC \geq 0.90	87%	-	85%	89% PFC \geq 0.90	85%	85%
80 PLUS Gold	-	90%	92% PFC \geq 0.90	89%	-	88%	92% PFC \geq 0.90	88%	88%
80 PLUS Platinum	-	92%	94% PFC \geq 0.95	90%	-	90%	94% PFC \geq 0.95	91%	91%
80 PLUS Titanium	90%	94% PFC \geq 0.95	96%	91%	90%	94% PFC \geq 0.95	96%	91%	91%

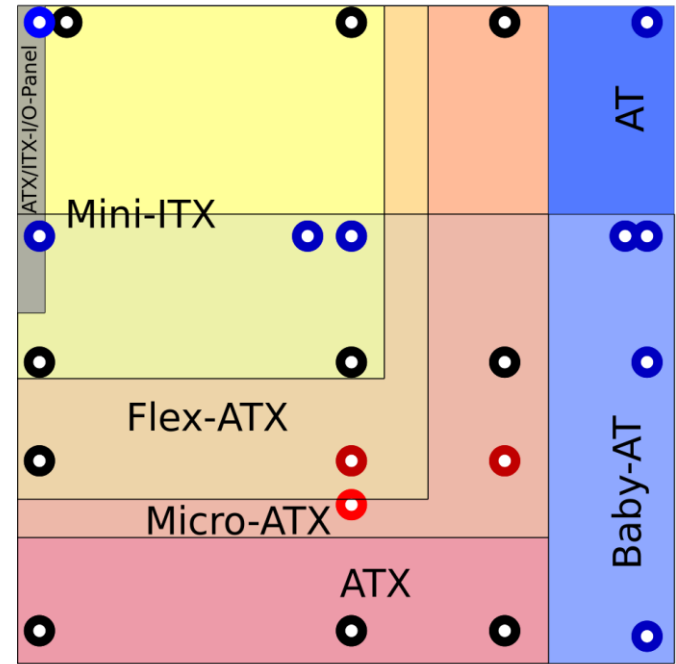
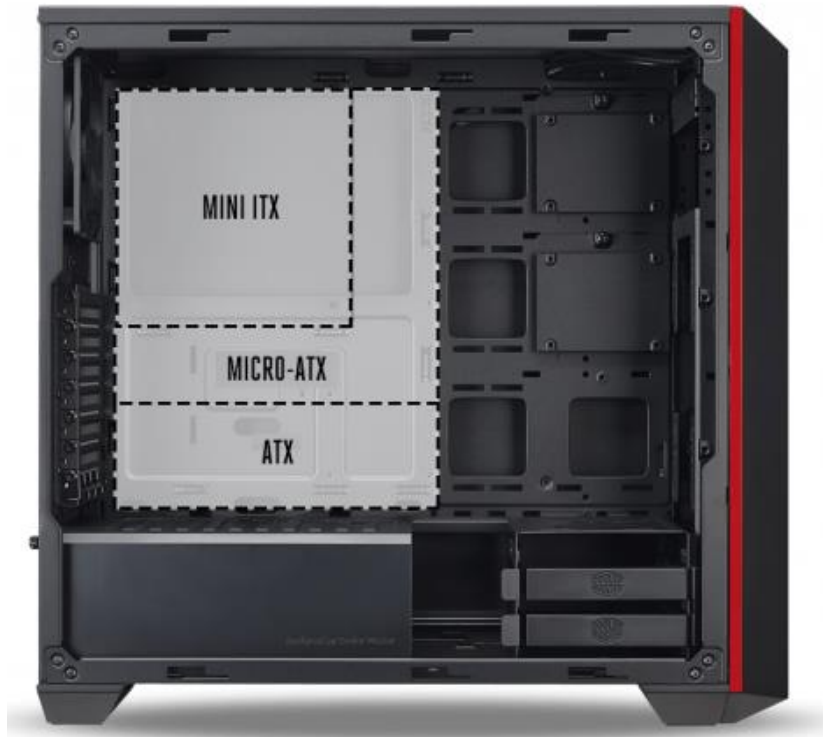
Материнська плата (Motherboard)



ASUS P5AD2-E Premium Motherboard



Форм-фактори материнських плат



Standard-ATX



Micro-ATX



Mini-ITX



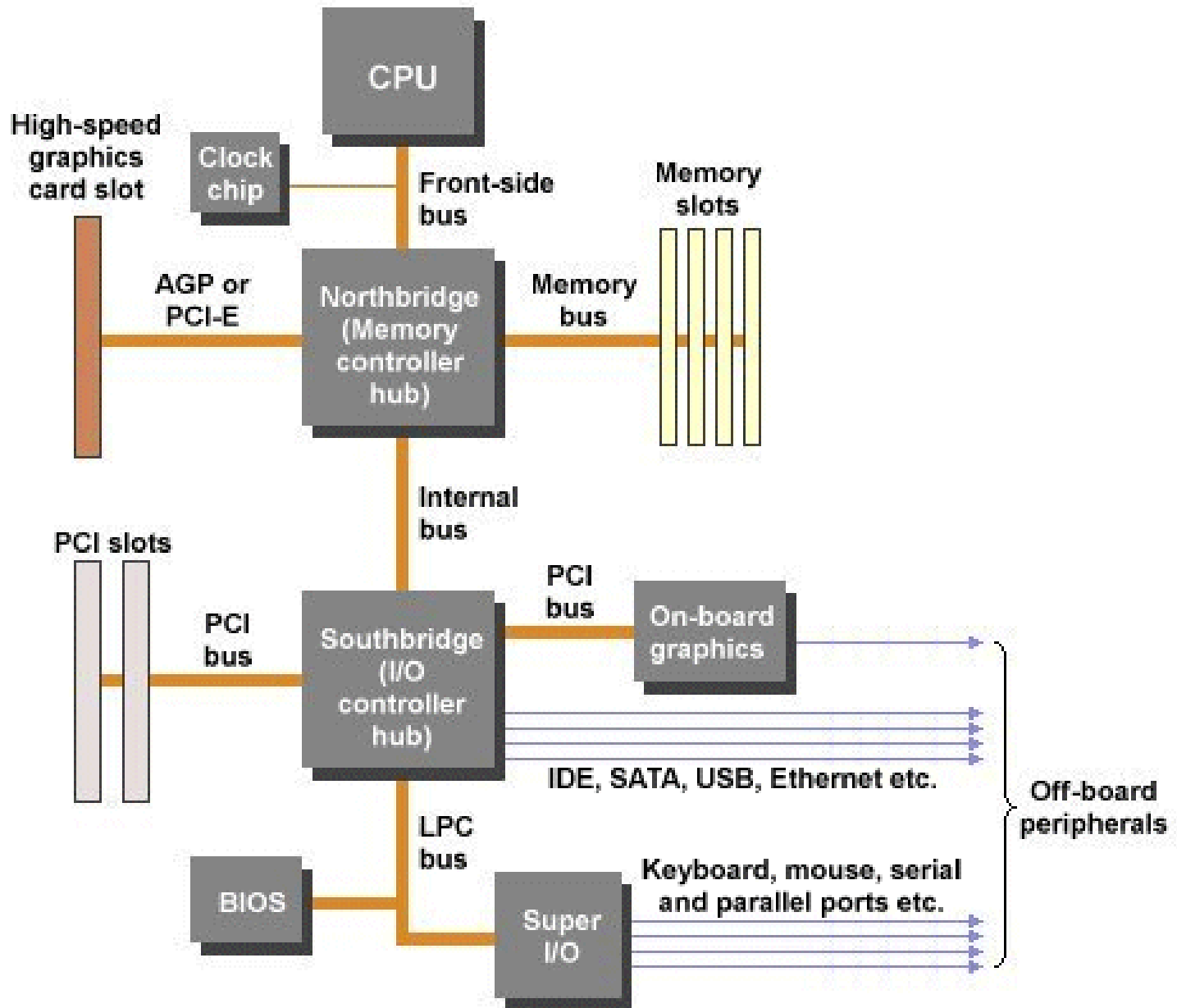
Nano-ITX



Pico-ITX



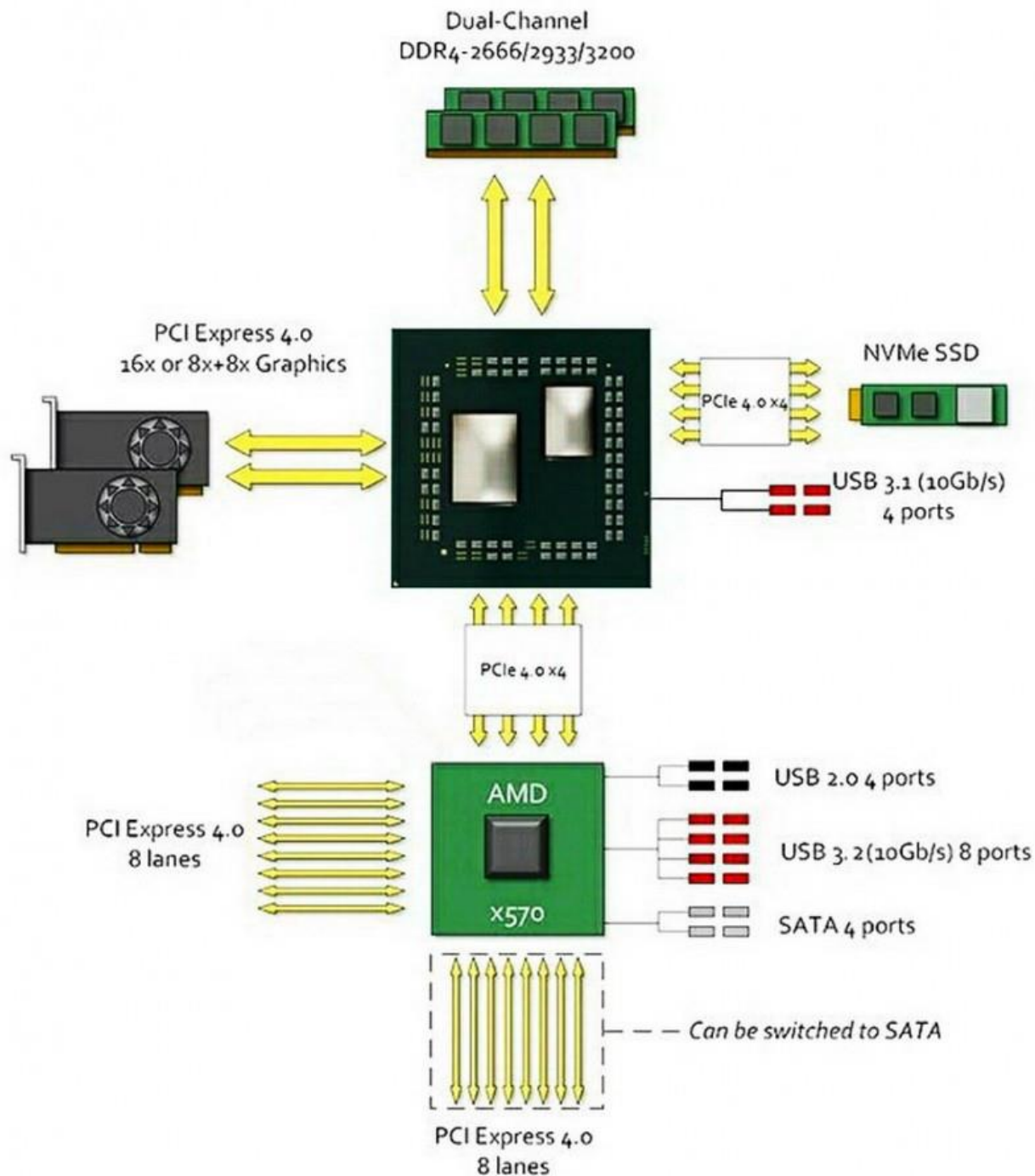
Блок-схема материнської плати



AMD
SOCKET
AM4

X570

AMD X570 Chipset





Центральний процесор (CPU)





Intel® Core™ Processors (14th Gen)

Featuring a hybrid architecture combining performance cores and efficient cores to optimize processing power and efficiency, along with overclocking capabilities,¹ Intel® Core™ processors (14th gen) offer efficacy enhancements that enable seamless multitasking and immersive entertainment experiences.



Intel® Core™ Ultra Processors

Give your PC a boost with artificial intelligence (AI) features¹ powered by Intel® Core™ Ultra processors with up to 24 total cores. Unlock new levels of creativity, productivity, gaming, collaboration, and professional-grade performance and security.²



Intel® Core™ Processors

Enjoy optimized gaming, content creation, and productivity and an immersive visual experience with our platform designed for performance and flexibility.



Intel® Xeon® Processors

Enable scalable performance with Intel® Xeon® 6 processors with Performance-cores (P-cores) and Efficient-cores (E-cores) for data centers, servers, the edge, and networking. Prioritize performance for demanding workloads or prioritize efficiency to help reduce costs in scalable environments.



Intel® Xeon® CPU Max Series

Satisfy growing compute needs for high-performance computing (HPC) and AI workloads with this scalable, balanced architecture featuring high-bandwidth memory and up to 56 P-cores.



Intel Atom® Processors

Get rugged, power-efficient, consistent performance for industrial use with up to eight E-cores, 32 execution units, and built-in AI capabilities ready for Industry 4.0.

13th Gen Desktop Processors: Unleashing the Ultimate Gaming Platform



Improved P-core cache architecture; More E-cores



Up to 24 cores (8P+16E) for Core i9 SKUs



Expanding Performance Hybrid Architecture¹ (6P+8E/6P+4E) to Core i5



Fast versatile connectivity with Thunderbolt 4² & Intel® Killer™ Wi-Fi 6E (Gig+)³



Intel 7 Process Technology



PCIe Gen 5.0 support⁴
PCIe Gen 4.0 support



Increase to DDR5-5600/
DDR5-5200 support⁵
DDR4 support
Up to 2X L2 cache
Increased L3 cache



Core and Memory Overclocking⁶
Intel Speed Optimizer



intel.



CHIPSET
Z790

Increased
Chipset
PCIe
Gen 4.0

Increased
USB 3.2
Gen 2x2
20Gbps

Intel® Core™ Desktop Processors (14th gen)

Unleashing the Ultimate Gaming Platform



Improved frequencies



Up to 24 cores



More E-cores¹ & greater L3 cache
On Intel Core i7



NEW Intel®
Application Optimization



Intel 7 Process
Technology

Intel
7

Support for
PCIe Gen 5.0²
& Gen 4.0



2-Ch support for
DDR5³ & DDR4



Intel® XTU with
"AI Assist"



Intel 600 & Intel 700
Series Chipset

Discrete Intel® Wi-Fi 7

5 Gig support

Integrated USB 3.2

Gen 2x2 20Gbps

intel.

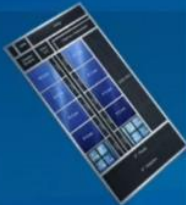
Intel® Application Optimization is a policy within Intel® Dynamic Tuning Technology that optimizes performance on select games, with the required configurations on select Intel® Core™ 14th Gen processors.
As of October 2023 AI Assist is supported on certain Intel® Core™ 14th gen unlocked SKUs. For more details on SKU support, see Intel® XTU download page.

Our Leadership Roadmap

Accelerated with 5 nodes in 4 years

Ultra Low Power
Performance

Hybrid



Disaggregated

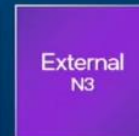


2021 - 2022
Alder Lake & Raptor Lake



Real World Performance

2023 - 2024
Meteor Lake & Arrow Lake



Leadership Compute, AI
and Graphics

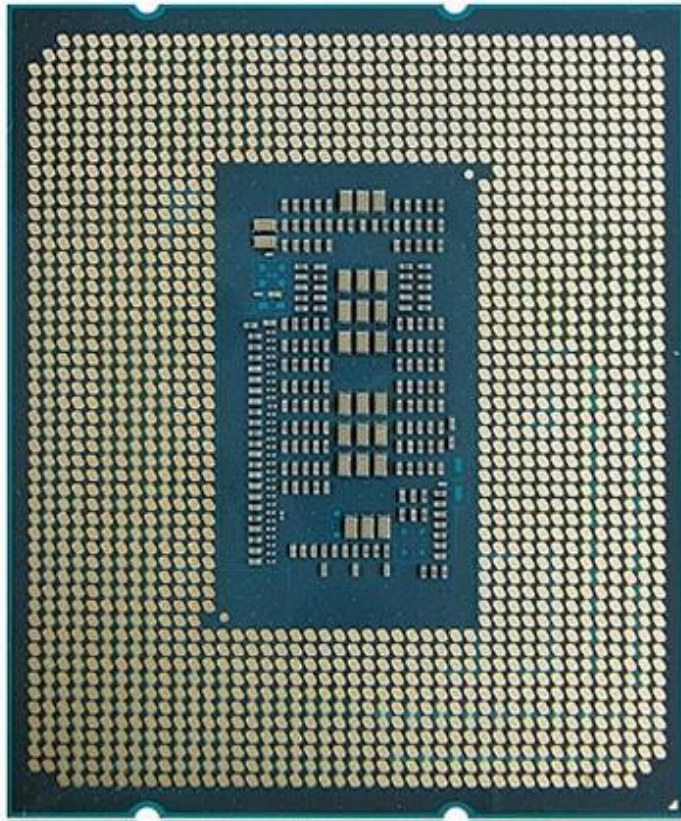
2024 +
Lunar Lake & Beyond



Performance per Watt
Leadership

All product plans and roadmaps are subject to change without notice.

Socket LGA1700



Intel Alder Lake-S
(LGA1700) 37.5x45.0 mm



Intel Comet Lake-S
(LGA1200) 37.5x37.5 mm



"ZEN 4" CORE ARCHITECTURE

2X

Expected

>15%

Up to

5GHz+

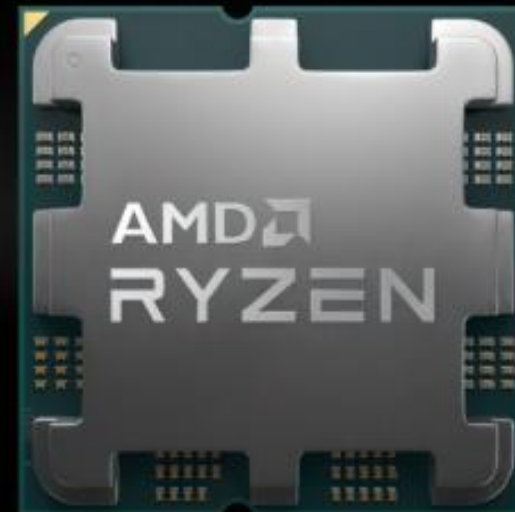
EXPANDED
INSTRUCTIONS

1MB Per Core L2 Cache

Single-Thread Uplift¹

Max Boost²


AI Acceleration



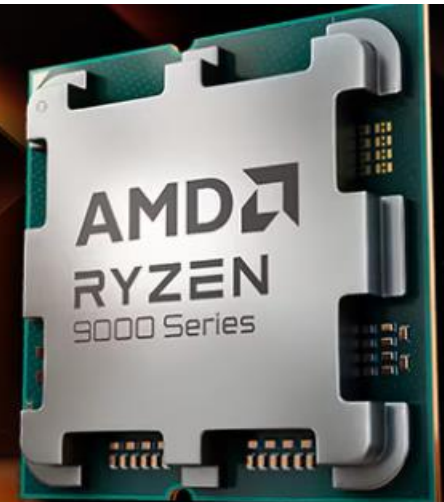


AMD Ryzen™ Processors for Desktops

For incredible gaming, professional-grade productivity, and magical AI experiences.¹



Buy on AMD.com 

Find Retailers





Ryzen 9000 Series

Name	Graphics Model	# of CPU Cores	# of Threads	Max. Boost Clock 	Base Clock 	Thermal Solution (PIB)	Graphics Core Count	Default TDP
AMD Ryzen™ 9 9950X3D	AMD Radeon™ Graphics	16	32	Up to 5.7 GHz	4.3 GHz	Not Included	2	170W
AMD Ryzen™ 9 9950X	AMD Radeon™ Graphics	16	32	Up to 5.7 GHz	4.3 GHz	Not Included	2	170W
AMD Ryzen™ 9 9900X3D	AMD Radeon™ Graphics	12	24	Up to 5.5 GHz	4.4 GHz	Not Included	2	120W
AMD Ryzen™ 9 9900X	AMD Radeon™ Graphics	12	24	Up to 5.6 GHz	4.4 GHz	Not Included	2	120W
AMD Ryzen™ 7 9800X3D	AMD Radeon™ Graphics	8	16	Up to 5.2 GHz	4.7 GHz	Not Included	2	120W
AMD Ryzen™ 7 9700X	AMD Radeon™ Graphics	8	16	Up to 5.5 GHz	3.8 GHz	Not Included	2	65W
AMD Ryzen™ 5 9600	AMD Radeon™ Graphics	6	12	Up to 5.2 GHz	3.8 GHz	AMD Wraith Stealth	2	65W
AMD Ryzen™ 5 9600X	AMD Radeon™ Graphics	6	12	Up to 5.4 GHz	3.9 GHz	Not Included	2	65W
AMD Ryzen™ 5 9500F	Discrete Graphics Card Required	6	12	Up to 5 GHz	3.8 GHz	AMD Wraith Stealth		65W

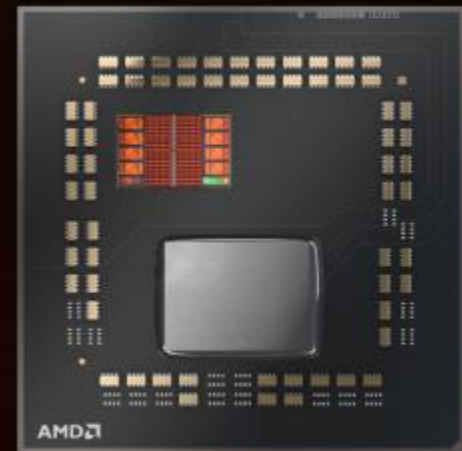


1ST GAMING CPU WITH 3D STACKING TECH

RYZEN™ **7** 5800X3D

8 Core	4.5 GHz Boost	64MB AMD 3D V-Cache™	105 W	AMD 400 Series
16 Thread	3.4 GHz Base	32MB 2D Cache	TDP	AMD 500 Series

AVAILABLE THIS SPRING FOR AMD SOCKET AM4



* See amd.com for G0-150.

INDUSTRY LEADING OPTIMIZED SILICON



2019

2024

Socket AM5



AMD AM5 VS AMD AM4

AMD vs Intel: Which CPUs Are Better in 2025?

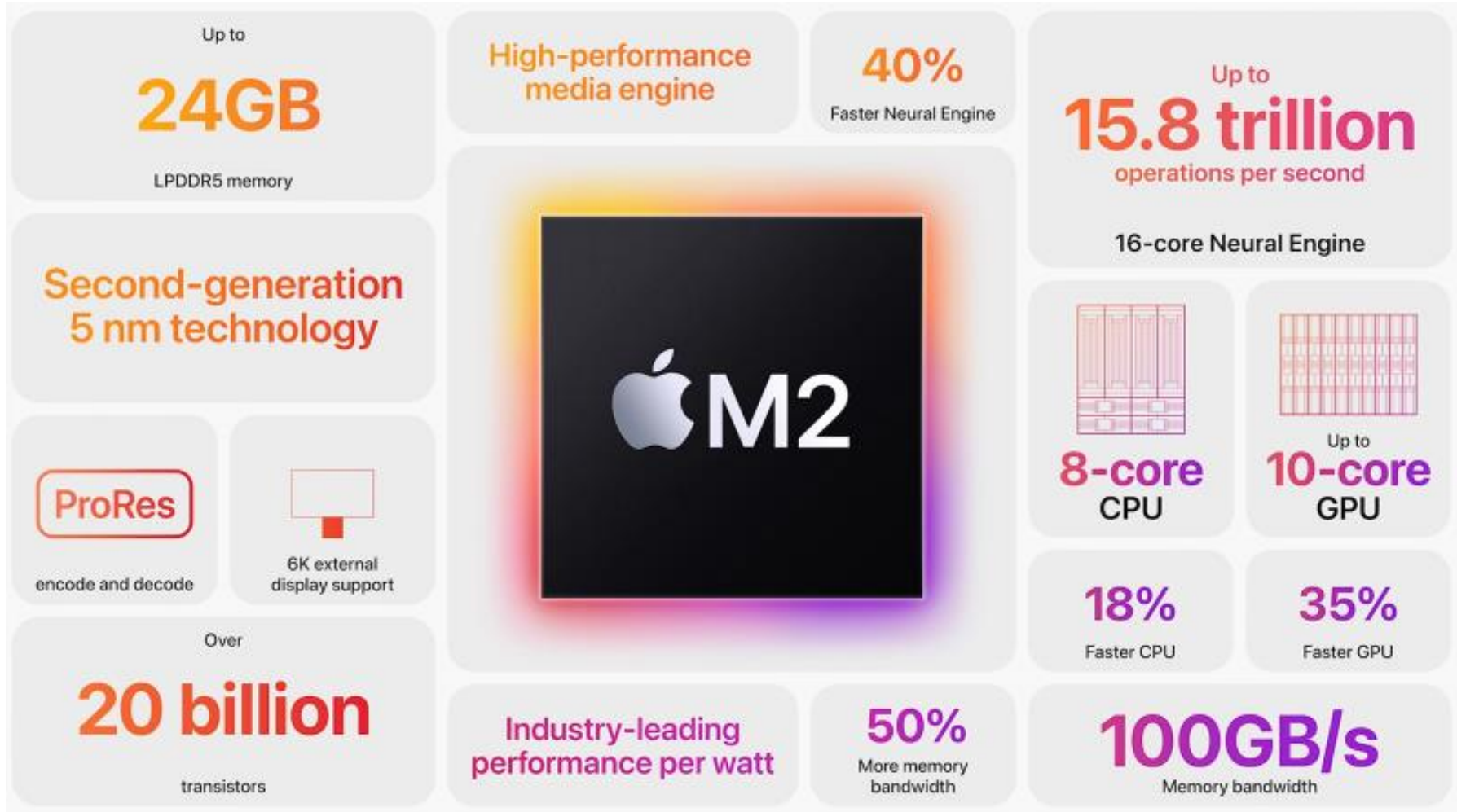
	Intel	AMD
CPU Pricing and Value	X	
Gaming Performance	X	X
Content Creation/Productivity	X	
Specifications	X	
Overclocking	X	
Power Consumption		X
Drivers and Software	X	
Process Node		X
Architecture	X	X
Security		X
Winner: Intel - Total	7	5

in 2024

	Intel	AMD
Pricing and Value		X
Gaming Performance		X
Productivity and Content Creation Performance	X	X
Specifications and Features	X	
CPU Power Consumption and Heat		X
CPU Drivers and Software	X	
Security		X
Total	3	5

in 2025

Apple M2




Apple M3


Feature	M3	M3 PRO	M3 MAX
Transistors	25 billion	37 billion	92 billion
GPU Architecture	Next-generation	Next-generation	Next-generation
GPU Rendering Speed	Up to 2.5x Faster GPU rendering		
Neural Engine	Faster 16-core Neural Engine		
CPU Cores	Up to 8-core CPU	Up to 12-core CPU	Up to 16-core CPU
GPU Cores	10-core GPU	18-core GPU	40-core GPU
Unified Memory	24GB	36GB	128GB
Media Engine	Advanced Media Engine with AV1 decode		
Dynamic Caching	Dynamic Caching		
Ray Tracing	Hardware-accelerated ray tracing		
Mesh Shading	Hardware-accelerated mesh shading		

M3 family performance cores

🍏 M3 family



🍏 M2 family



15% faster

🍏 M1 family



30% faster

Apple M4



The graphic features a central square with the Apple logo and 'M4' on a blue-to-yellow gradient background. Surrounding this are various performance metrics and features in dark rounded rectangles. On the left, there's a 3D scene of a red dragon-like creature. On the right, there are two grid diagrams representing CPU and GPU cores. At the bottom, there's a '3 nm technology' label with 'Second-generation' above it.

120GB/s
Unified memory bandwidth

Tandem OLED display engine

Dynamic Caching

Up to

10-core
CPU

10-core
GPU

Hardware-accelerated mesh shading

Hardware-accelerated ray tracing

Up to

50%
faster CPU than M2

Up to

4x
faster GPU than M2

ProRes

AV1

Over

28 billion transistors

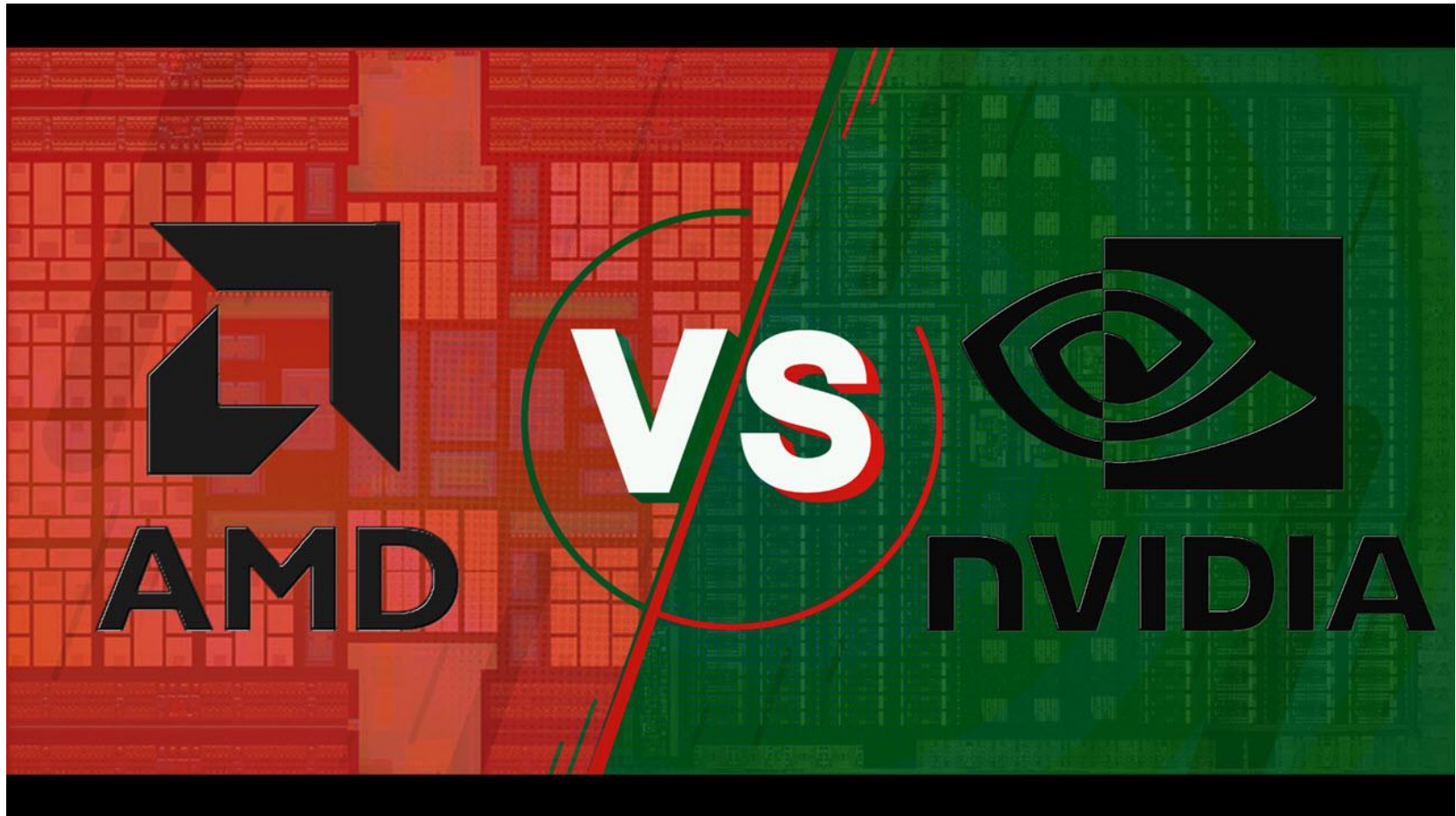
Second-generation

3 nm technology

Neural Engine with

38 trillion ops/sec

Відеокарта (GPU)





GeForce RTX 40 Series

BEYOND FAST

NVIDIA® GeForce RTX™ 40 Series GPUs are beyond fast for gamers and creators. They're powered by the ultra-efficient NVIDIA Ada Lovelace architecture which delivers a quantum leap in both performance and AI-powered graphics. Experience lifelike virtual worlds with ray tracing and ultra-high FPS gaming with the lowest latency. Discover revolutionary new ways to create and unprecedented workflow acceleration.

[See All Buying Options](#)



	GeForce RTX 4090	GeForce RTX 4080	GeForce RTX 4070 Ti	GeForce RTX 4070	GeForce RTX 4060 Ti	GeForce RTX 4060
NVIDIA CUDA Cores	16384	9728	7680	5888	4352	3072
Boost Clock (GHz)	2.52	2.51	2.61	2.48	2.54	2.46
Memory Size	24 GB	16 GB	12 GB	12 GB	16 GB or 8 GB	8 GB
Memory Type	GDDR6X	GDDR6X	GDDR6X	GDDR6X	GDDR6	GDDR6





NVIDIA RTX 5090 vs. 4090

VideoCardz.com

RTX 5090 FE

RTX 4090 FE

Picture

[To be Leaked]



	RTX 5090 FE	RTX 4090 FE
GPU	GB202	AD102
Architecture	Blackwell	Ada Lovelace
Total SMs	Less than 192	128
CUDA Cores (Assumed)	Less than 24576	16384
Base Clock	~2.9 GHz	~2.23 GHz
Boost Clock	TBC	~2.52 GHz
Memory	28 GB GDDR7	24 GB GDDR6X
Memory Bus	448-bit	384-bit
Memory Speed	28 Gbps	21 Gbps
Memory Bandwidth	1568 GB/s	1008 GB/s
Power Connectors	1x 12VHWR (16-pin) (?)	1x 12VHWR (16-pin)
Default TGP	TBC	450W
Founders Edition Design	2-slot, dual-fan	3-slot, dual-fan
MSRP	TBC	1599 USD
Announcement Date	Late 2024	October 12th, 2022



Game. Stream. Advance.

Introducing the AMD Radeon™ RX 7000 Series Graphics Cards

AMD
RADEON
RX 7000 Series

Model Specifications

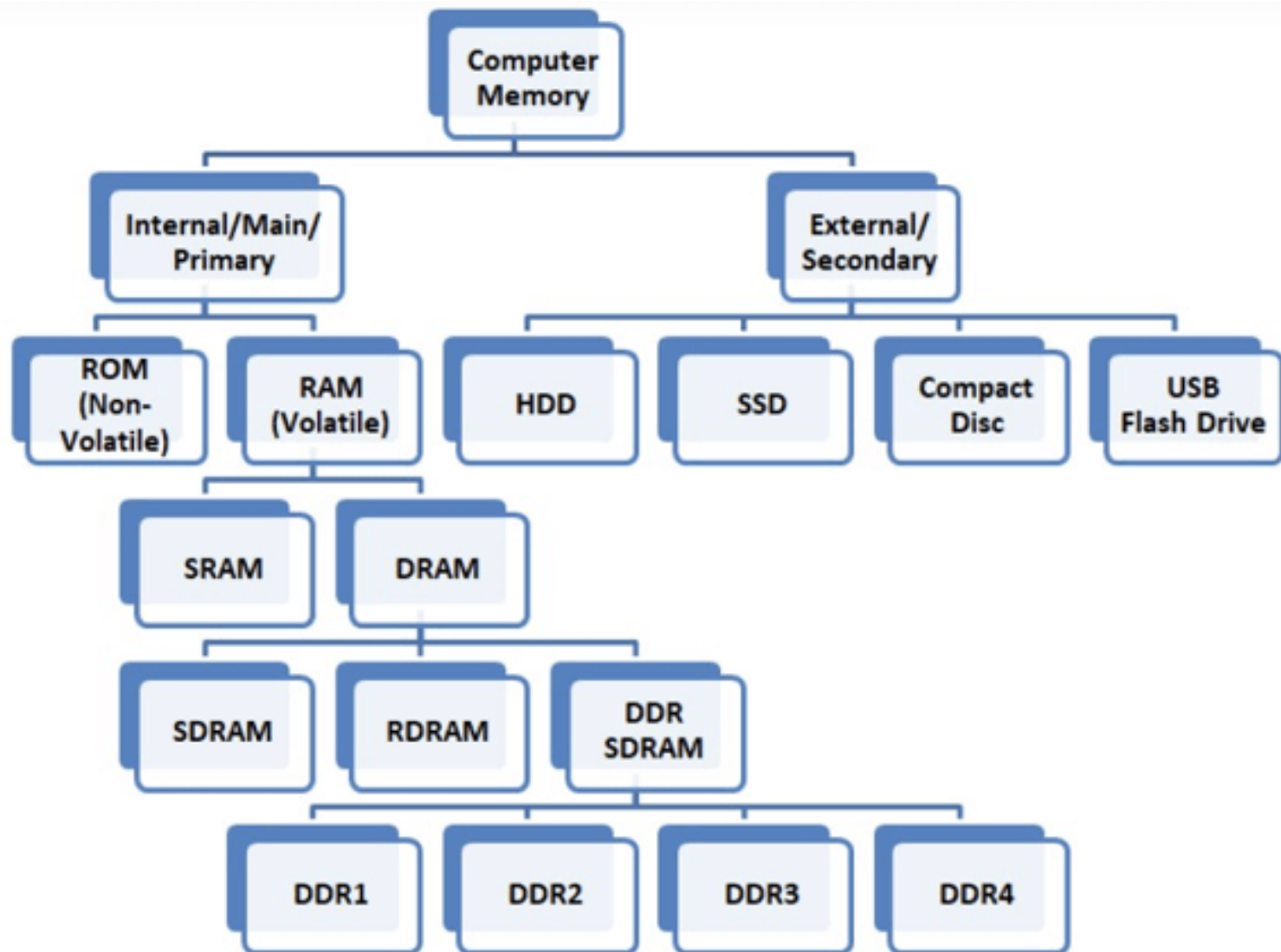
MODEL	COMPUTE UNITS	RAY ACCELERATORS	GAME FREQUENCY ⓘ	INFINITY CACHE	MAX MEMORY SIZE	MEMORY TYPE
AMD Radeon™ RX 7900 XTX	96	96	2300 MHz	96 MB	24 GB	GDDR6
AMD Radeon™ RX 7900 XT	84	84	2000 MHz	80 MB	20 GB	GDDR6
AMD Radeon™ RX 7900 GRE	80	80	1880 MHz	64 MB	16 GB	GDDR6
AMD Radeon™ RX 7600	32	32	2250 MHz	32 MB	8 GB	GDDR6

AMD vs Nvidia: Who Makes the Best GPUs?

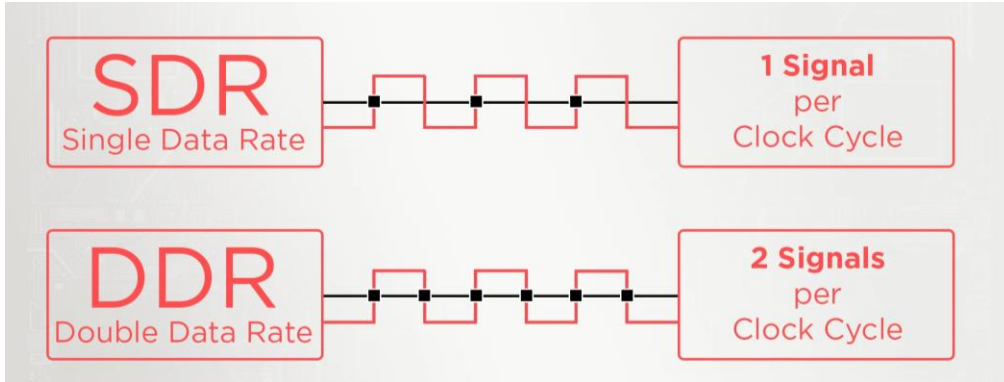
Graphics Card	1080p FPS	1440p FPS	4K FPS	Price (MSRP)	Avg. Power
GeForce RTX 5090	157	141.8	102	\$3,000 (\$2,000)	394W
GeForce RTX 5070 Ti	123.7	98.5	58.8	\$930 (\$750)	259W
Radeon RX 9070 XT	118	94.1	57.0	\$800 (\$600)	280W
GeForce RTX 5070	105.3	78.2	44.8	\$650 (\$550)	220W
GeForce RTX 5060 Ti 16GB	82.0	59.7	33.52	\$490 (\$429)	180W
Radeon RX 9060 XT 16GB	76.6	55.7	31.2	\$390 (\$349)	160W
GeForce RTX 5060	67.9	43.4	18.6	\$339 (\$299)	145W
Intel Arc B570	56.9	33.5	13.9	\$260 (\$220)	136W

<https://www.tomshardware.com/reviews/best-gpus,4380.html>

Пам'ять комп'ютера



DDR SDRAM



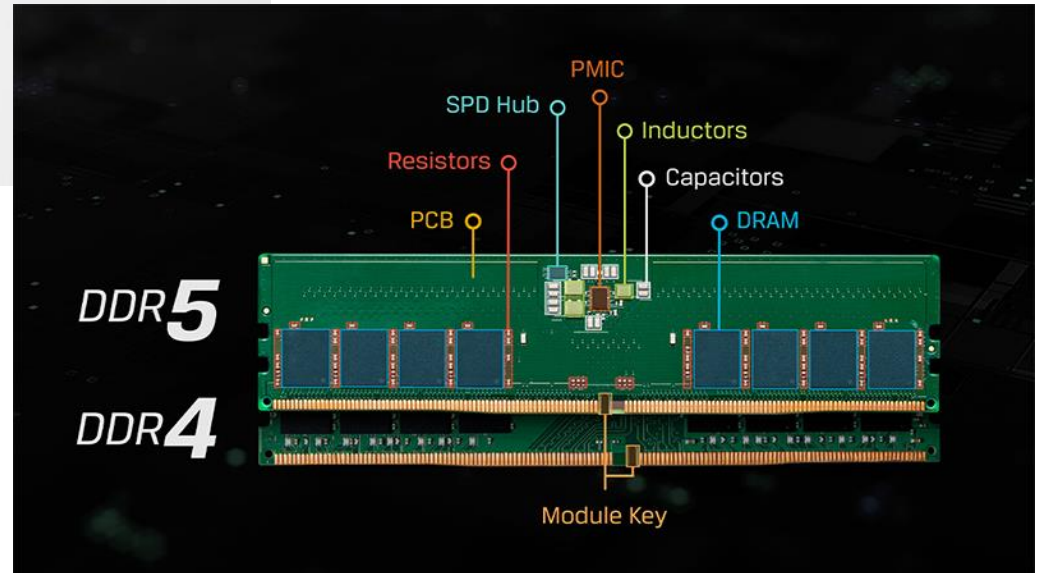
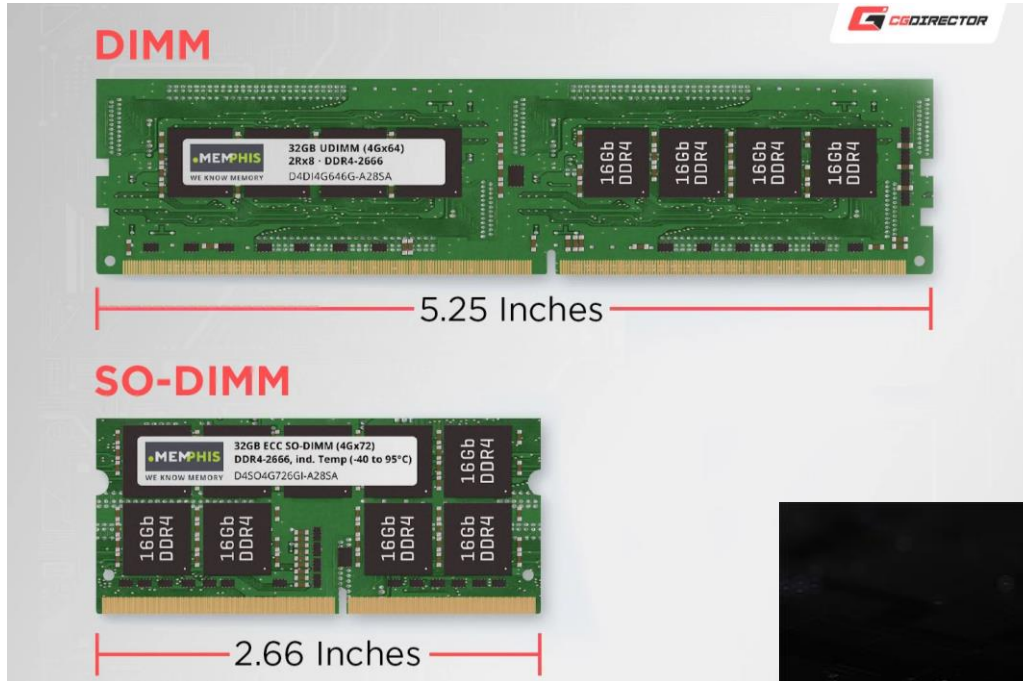
There are five generations of DDR SDRAM:

- DDR (Introduced in 2000)
- DDR2 (Introduced in 2003)
- DDR3 (Introduced in 2007)
- DDR4 (Introduced in 2014)
- DDR5 (Introduced in 2021)

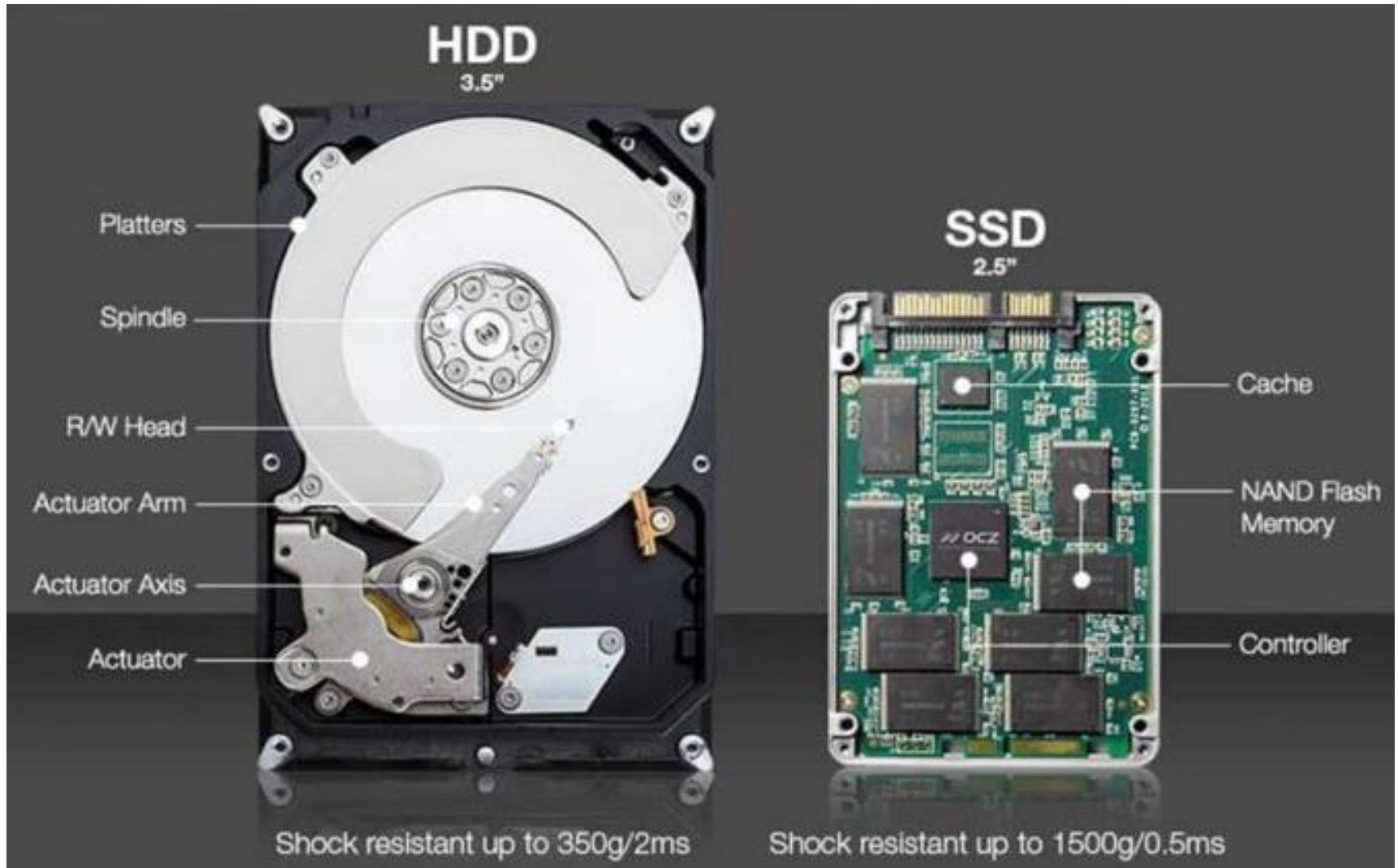


	JEDEC standard	OC modules
DDR	up to 400 MT/s	up to 533 MT/s
DDR2	up to 1,066 MT/s	up to 1,333 MT/s
DDR3	up to 2,133 MT/s	up to 2,666 MT/s
DDR4	up to 3,200 MT/s	up to 5,333 MT/s
DDR5	up to 6,400 MT/s	up to 8,4000 MT/s
DDR6*	up to 12,800 MT/s	up to 16,800 MT/s

PC RAM vs. Laptop RAM



Постійний запам'ятовуючий пристрій





SSD vs. HDD

Usually 10,000 or 15,000 rpm
SAS drives



0.1 ms	Access Times SSDs exhibit virtually no access time	5.5-8.0 ms
SSDs deliver at least 6000 io/s	Random I/O Performance SSDs are at least 15 times faster than HDDs	HDDs reach up to 400 io/s
SSDs have a failure rate of less than 0.5%	Reliability This makes SSDs 4-10 times more reliable	HDDs failure rate fluctuates between 2-5%
SSDs consume between 2 and 5 watts	Energy Savings This means that on a large server, approximately 100 watts are saved	HDDs consume between 6 and 15 watts
SSDs have an average I/O wait of 1%	CPU Power You will have an extra 6% of CPU power for other operations	HDDs average I/O wait is about 7%
The average service time for an I/O request while running a backup remain below 20 ms	Input/Output Request Times SSDs allow for much faster data access	The I/O request time with HDDs during backup rises up to 400-500 ms
SSD backups take about 6 hours	Backup Rates SSDs allow for 3-5 times faster backup for your data	HDD backups take up to 20-24 hours



SSD

vs

HDD



faster



slower

more expensive



cheaper

non-mechanical (flash)



mechanical (moving parts)

shock-resistant



fragile

best for storing operating systems, gaming apps, and frequently used files

best for storing extra data, such as movies, photos, and documents

Фізичні розміри HDD та SSD



3.5" HDD



2.5" HDD



2.5" SSD



M2 SSD



mSATA SSD

SSD form factors



2.5" 15mm U.2 SAS



2.5" 15mm U.2 PCIe



Half-height,
half-length (HHHL)
AIC PCIe



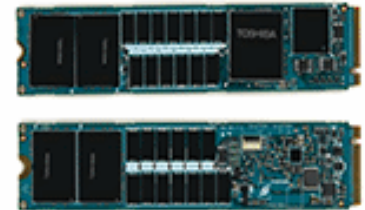
2.5" 7mm SATA



Ball grid array (BGA)
surface-mount (M.2 1620)
and removable
module (M.2 2230)



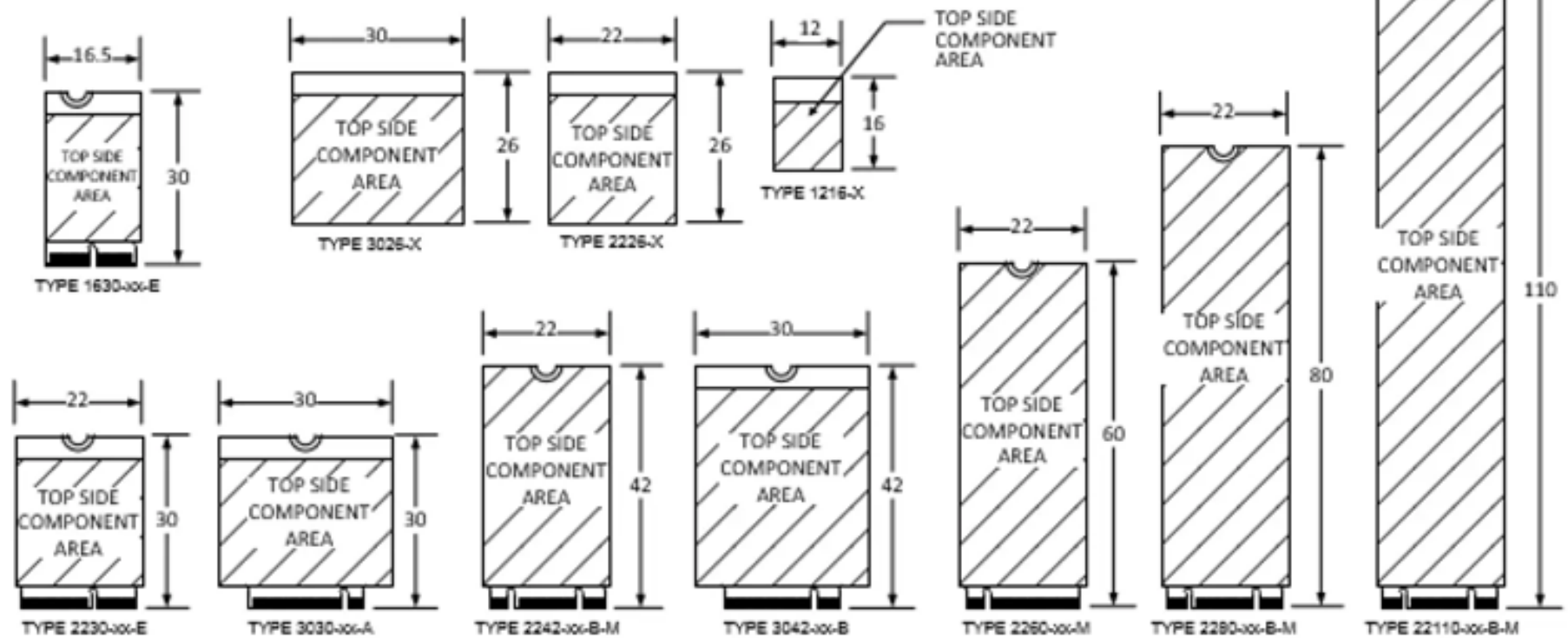
M.2 2280



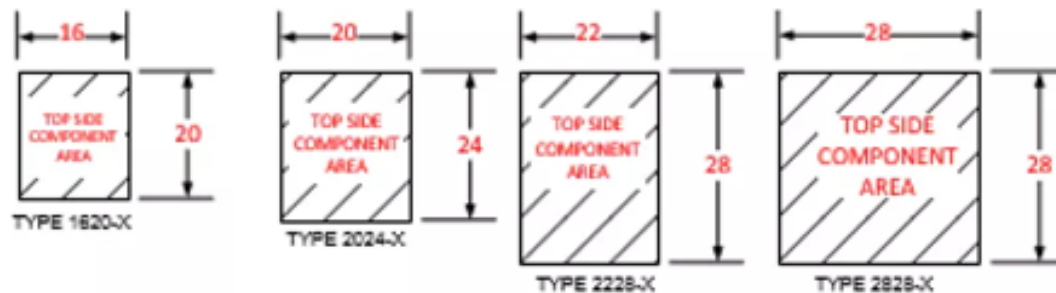
M.2 22110

M.2 Family of Form Factors

Modules:



BGAs:



Накопичувачі на оптичних дисках (OSD)



Compact Disc (CD)
Capacity: 700 MB
Available from 1982

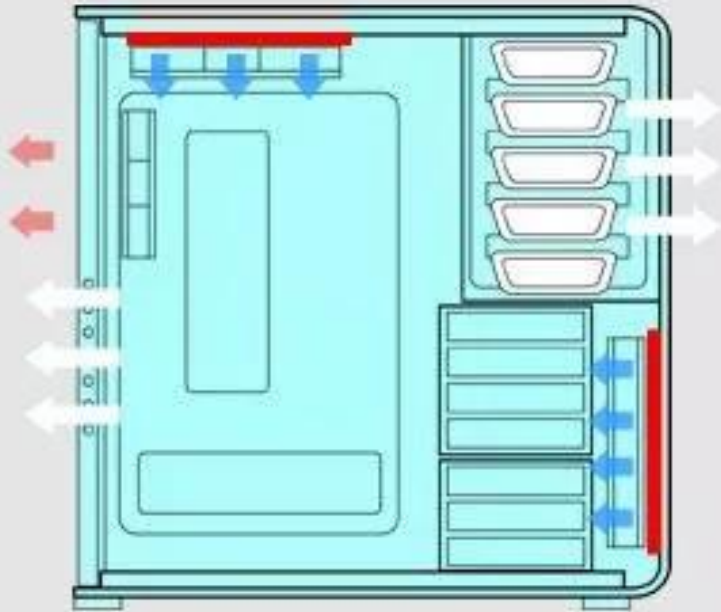


DVD
Capacity: 4.7 GB
Available from 1995



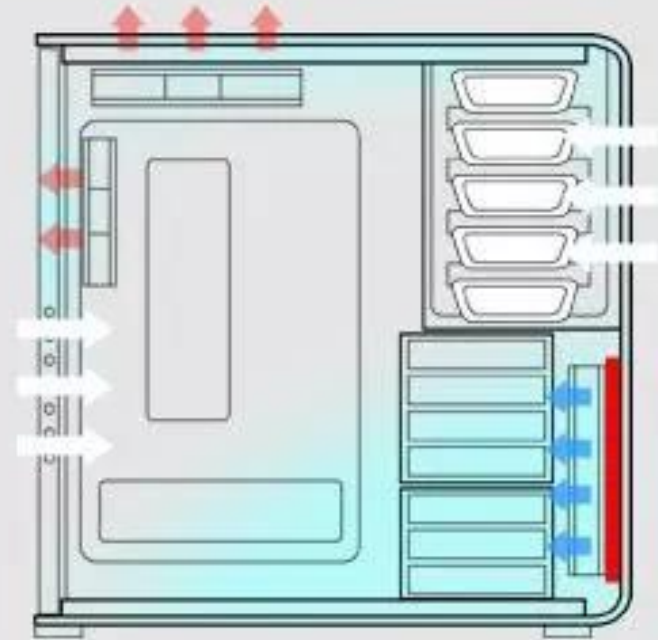
Blu-ray Disc
Capacity: 25 GB
Available from 2006

Організація охолодження системного блоку



Positive pressure computer system

Chassis with positive air pressure
(With filter on top fan)



Negative pressure computer system

Chassis with negative air pressure
(Without filter on top fan)



Tiny stream



Flow



Dusty air



Dustless air

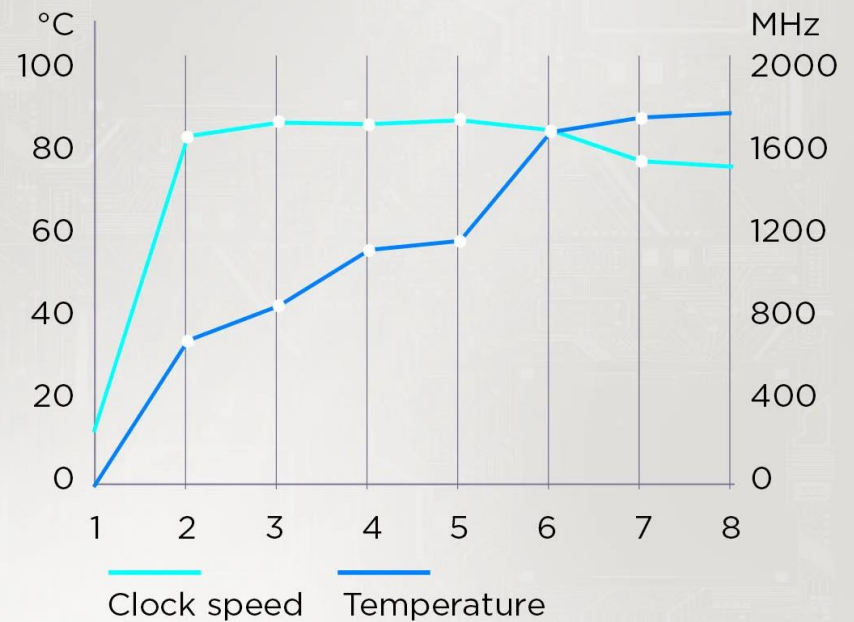


Filiter

Тротлінг (Throttling)



Thermal throttling causes CPU clock speed reduction at high temperatures. Especially under sustained loads, i.e. rendering.

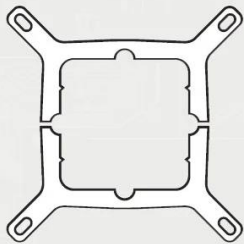


Організація охолодження системного блоку

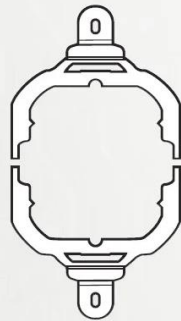


Монтаж процессорного кулера

Mounting mechanisms can vary depending on your processor and socket



Intel



AMD

Most premium coolers come with mounting brackets for several popular AMD & Intel CPUs and Sockets



Дякую за увагу!