

Gaming notebook PC display frame rates will upgrade to 240Hz and 360Hz in 2021

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Key findings

- The core gamer market focuses on 240–300 hertz (Hz) frame rates with a 72% color gamut. However, 165Hz is expected to take over the core gamer market in 2021 because of cost considerations. Meanwhile, 300Hz will upgrade to 360Hz in 2021. Hence, the high-end core gamer segment will focus on 360Hz with a 72% color gamut, while mainstream core gamers will focus on 165Hz with a 72% color gamut.
- The panel price gap between a 45% NTSC color gamut and a 72% NTSC color gamut is \$30, while the price gap between 60Hz and 144Hz is \$15–20. However, the price gap between 144Hz and 240Hz is as high as over \$50.

High frame rate (HFR) is a must-have and continuously upgrading feature among gaming notebook PC displays.

In 2019, 3.9 million gaming notebook PCs with HFR panels were shipped. Display makers included AU Optronics (AUO) with 1.1 million shipments, LG Display with 0.8 million shipments, CEC Panda with 0.85 million shipments, Innolux Corporation (Innolux) with 0.6 million shipments, and BOE Technology with 0.55 million shipments. CEC Panda used oxide thin-film-transistor liquid-crystal display (TFT-LCD) technology to produce gaming notebook PC panels, whereas AUO used low-temperature polycrystalline silicon (LTPS) TFT-LCD technology to develop gaming PC displays for some models.

The major notebook PC brands and OEMs that adopt these gaming displays are ASUSTeK Computer Inc. (ASUS), Lenovo Group Ltd. (Lenovo), Hewlett-Packard Company (HP), Micro-Star International (MSI), Dell Technologies Inc. (Dell), and Acer Inc. (Acer).

There are several different frame rate specifications (or the so-called driving frequency): 60Hz, 120Hz, 144Hz, 165Hz, 240Hz, 300Hz, and 360Hz. The trend is moving toward higher frequencies. The display panels' price gaps, depending on the frame rate, can be high as \$20–35. Different segments in the gaming notebook display market have different frame rates. The gaming notebook PC display market can be divided into three segments:

- Gaming expert: This segment consists of professional gamers such as competitive players and content designers. This also includes heavy gamer communities. This is the gaming PC's commercial market.
- Core gamer: This segment consists of mainstream gaming notebook PC users. This is the gaming PC's commercial market.
- Light gamer: This segment consists of consumers that do not play games as their main application, rather they play games in their notebook PCs from time to time. Hence, they are encouraged to care about the frame rate, color gamut, and wide-view angle specifically to match gaming applications.

In terms of supply, shipments of panels with frame rates above 120Hz were close to 465,000 units in 2017, and shipments likely reached 1.87 million units in 2018. Omdia expected shipments of HFR notebook displays to reach 3 million units in 2019.

In terms of demand, gaming notebook brands used 60Hz panels in 2017, and shipments were close to 3.9 million units. Shipments increased by more than 50% year-over-year (YoY) in 2018 to 6 million

units. The gaming market had become a profitable segment for PC brands, and they targeted a shipment of 6.9 million units for 2019.

Most gaming brands prefer adopting 60Hz for their light gaming notebooks and 144Hz for their premium gaming notebooks because of the difference in cost between 60Hz, 120Hz, and 144Hz. However, mid-range and low-end models will continue to use 120Hz. Omdia expects brands to engage in a price war against low-end gaming models with twisted nematic (TN) 120Hz and in-plane switching (IPS) 60Hz displays.

The current difference in panel prices is shown in **Table 1**.

Table 1: Notebook PC displays' prices by different gaming specifications

Specifications	Entry-level			Mid-range				High-end			
	Reference prices (\$)			Reference prices (\$)				Reference prices (\$)			
15.6", FHD, TN, 45% NTSC, 60Hz	\$35										
15.6", FHD, IPS, 45% NTSC, 60Hz		\$40									
15.6", FHD, IPS, 72% NTSC, 60Hz			\$70			\$70					
15.6", FHD, IPS, 72% NTSC, 144Hz				\$85	\$85		\$85	\$85	\$85	\$85	
15.6", FHD, IPS, 72% NTSC, 240Hz										\$130	\$130

Source: Omdia

The panel price gap between a 45% NTSC color gamut and a 72% NTSC color gamut is \$30, while the price gap between 60Hz and 144Hz is \$15–20. However, the price gap between 144Hz and 240Hz is as high as over \$50.

Graphics processing units (GPUs), such as NVIDIA's, Advanced Micro Devices, Inc.'s (AMD's), or Intel Corporation's (Intel's) solutions also play key roles in the evolution of gaming PC displays. A faster frame rate display needs a better GPU to provide the best gaming experience.

In 2020 and 2021, gaming display makers are starting to upgrade notebook PC panel specifications as shown in **Table 2**.

Table 2: Trend of gaming notebook PC specifications: 2017–21

Gaming NB	2017	2018	2019	2020	2021
Gaming expert	FHD TN 120Hz 72% color gamut	UHD IPS 60Hz Adobe RGB color gamut	UHD IPS 120Hz Adobe RGB	UHD IPS 120Hz Adobe RGB color gamut	UHD IPS 144Hz Adobe RGB color gamut
		FHD IPS 144Hz 72% color gamut			
Core gamer	FHD IPS 72% color gamut	FHD IPS 120Hz 72% color gamut	FHD IPS 144Hz 72% color gamut	FHD IPS 300Hz 72% color gamut	FHD IPS 360Hz 72% color gamut
		FHD TN 120Hz 72% color gamut			
Light gamer	FHD TN 60Hz 60– 72% color gamut	FHD IPS 60Hz 45% color gamut	FHD IPS 120Hz 45% color gamut	FHD IPS 144Hz 45% color gamut	FHD IPS 144Hz 45% color gamut
		FHD TN 60Hz 45% color gamut	FHD IPS 60Hz 45% color gamut	FHD IPS 60Hz 45% color gamut	FHD IPS 120Hz 45% color gamut

Source: Omdia

With GPU upgrades, notebook displays trend toward higher frame rates with faster response times as the highest priority, followed by higher resolution and higher color gamut. Recently, high dynamic range (HDR) for gaming began development, so mini LEDs will start being used in gaming notebook PCs. Moreover, Omdia foresees low blue light as another option for gaming notebooks to adopt in the future.

IPS liquid crystal is a must in gaming notebook PC displays. IPS is the general name of the technology; different display manufacturers name their IPS models differently. For example, AUO's advanced hyper-viewing angle (AHVA), Innolux's azimuthal anchoring switch (AAS), and BOE's advanced super dimension switch (ADS). Meanwhile, LG Display, CEC Panda, and Sharp simply call it IPS.

The main specification for light gamers is 60Hz or 140Hz frame rate with a 45% color gamut in 2020. In 2021, 60Hz frame rate is expected to be obsolete in the gaming community, even among light gamers. This is due to the prevalence of new gaming GPUs that do not support 60Hz anymore. For light gamers, FHD (1920x1080) resolution, 120–144Hz, 45% color gamut, and IPS wide-view angle mode are key.

The main specification for core gamers is 240–300Hz HFR with a 72% color gamut. However, 165Hz is expected to take over the core gamer market in 2021 because of cost considerations. Meanwhile, 300Hz will upgrade to 360Hz in 2021. Hence, the high-end core gamer segment will focus on 360Hz with a 72% color gamut, while mainstream core gamers will focus on 165Hz with a 72% color gamut.

The market is also evolving for gaming experts, or so-called premium gamers. Professional gamers do not necessarily consider 360Hz HFR as a must because of its overly high cost, but frame rates will evolve from 120Hz to 165Hz in 2020 and 144Hz to 240Hz in 2021. Most importantly, color gamut will be required to move from the traditional NTSC 72% to Adobe RGB and DCI-P3, and the resolution will improve to quad high definition (QHD) of 2560x1440 or ultra-high definition (UHD) of 4000x2000 or 3840x2160. Although the premium gaming market does care about frame rates, it places the most importance on resolution and color saturation.

Table 3 shows the panel makers' roadmaps for their gaming notebook PC panels and their display technologies.

Table 3: HFR notebook PC display makers' roadmaps

	AUO	Innolux	LG Display	BOE	CEC Panda	Sharp	Panasonic
360–480Hz FHD	R&D stage Mass production in 2021		R&D stage, Mass production in 2021				
300Hz FHD	3Q19–Q420 (LTPS TFT-LCD)					4Q19–Q420 (Oxide TFT)	
240Hz FHD	Late design, began mass production in 3Q19	4Q19–Q420 (LTPS TFT-LCD)	4Q19–Q420 (Oxide TFT-LCD)	3Q19–Q420 (a-Si TFT-LCD)		First caught market attention (Dell, HP, Lenovo, ASUS, Acer) in March 2019	
165Hz QHD	Developed to match NVIDIA's GPU spec						
165Hz FHD	2Q19–Q420 (LTPS)		4Q19–Q420 (a-Si TFT-LCD)	3Q19–Q420 (a-Si TFT-LCD)			Open cell panels to Chinese modules, agents, and OEMs
144Hz FHD	Mass-producing for HP, ASUS, Acer, Lenovo, and Dell	3Q19–Q420 (16.1" for Huawei)	Mass-producing for HP, ASUS, Acer, Lenovo, and Dell	Mass-producing for local Chinese brands only	ASUS adaption		
120Hz UHD	Mass-producing for Dell in 2020			3Q19–Q420 (a-Si TFT-LCD)			
120Hz FHD	Has plans for low-end gaming models	Mass-producing for TN models only		Mass-producing	Low-end gaming models for ASUS and Xiaomi		Open cell panels to Chinese modules, agents, and OEMs
Strategy	Market leader, cooperated with NVIDIA	A lack of IPS capacities for gaming displays	Followed AUO owing to its small quantity of gaming displays	Targeted FreeSync and cooperates with Chinese gaming brands	Its low-end gaming models have aggressive pricing	Its premium models have aggressive pricing	OEM/module house

Source: Omdia

Omdia notes the following display maker strategies:

- AUO: The market shipment and specification leader in terms of HFR notebook PC panels
- Innolux: Plans to install more AAS (IPS) capacities
- LG Display: Following AUO
- BOE: Matching FreeSync's GPU instead of NVIDIA and cooperates with Chinese local gaming PC brands
- CEC Panda: Using oxide TFT-LCD in its gaming PC displays but also offers premium gaming models at aggressive prices
- Sharp: Using oxide TFT-LCD in its gaming PC displays but also offers premium gaming models at aggressive prices
- Panasonic: Gradually retreating from the gaming notebook PC market for the time being. Panasonic is focusing on its open cell business model with China's module agencies and OEMs

Appendix

Further reading

[Large Area Display Market Tracker](#) (August 2020)

[Large Area Display Product Roadmap Tracker](#) (August 2020)

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