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Automotive HUD Industry Report, 2021

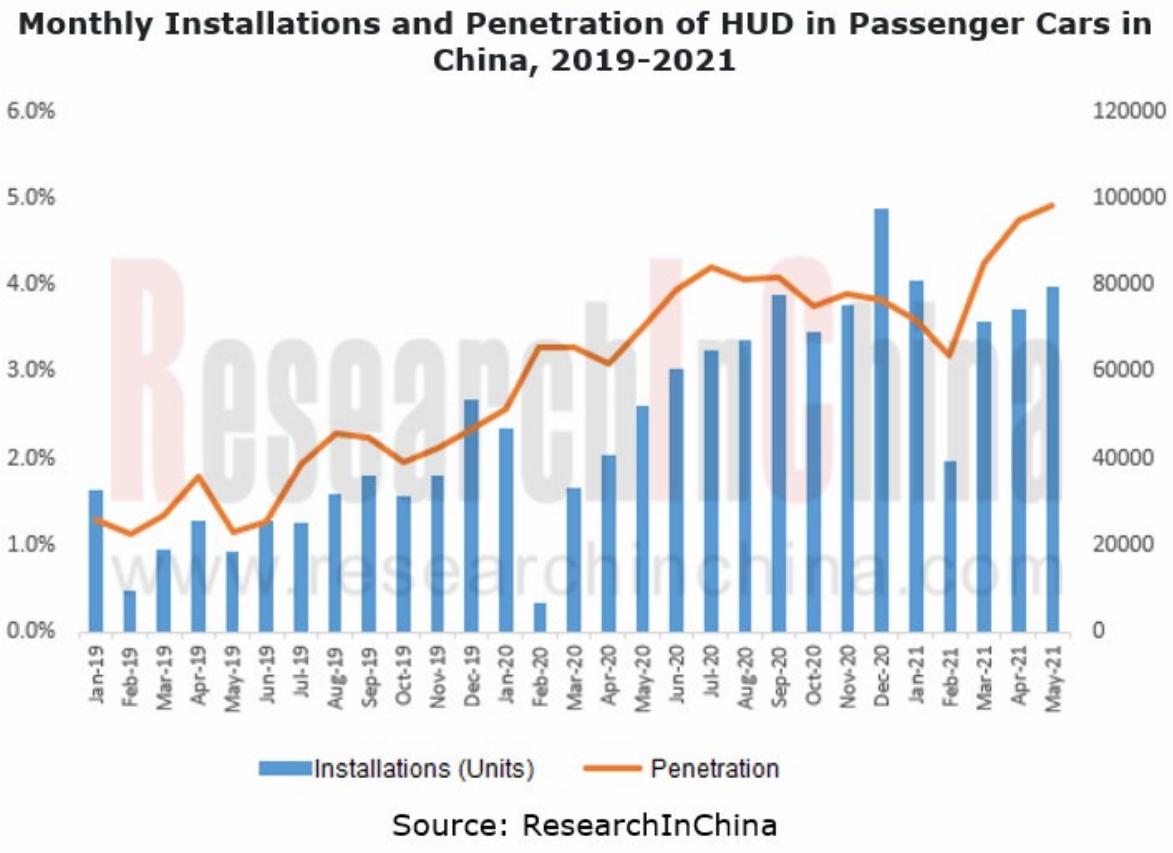
Abstract

HUD industry research: rapid adoption of OEM HUD in vehicles is under way and Chinese auto brands perform well.

Head-up display (HUD) projects key information onto the transparent media or windshield before the driver for him/her to look down on the cluster and navigation less frequently. So far there have been three types of HUDs mass-produced: C-HUD, W-HUD and AR-HUD.

In 2025, the penetration of OEM HUD in China will outstrip 30%. According to our statistics, in 2020, 692,000 passenger cars in China packed OEM HUDs, an annualized spurt of 101.2%, with the penetration up to 3.7%, 2.0 percentage points higher than the previous year. In 2021, the penetration of HUD sustains growth and is expected to be 8% or so at the end of the year, compared with nearly 5% in the first half. It is conceivable that the figure will exceed 30% in 2025.

Three reasons stand out. First, larger size and more information displayed make HUD a third screen for an intelligent cockpit, which is accompanied by higher level of vehicle intelligence and upgrade of projection technology. Second, Chinese leading automakers like Great Wall Motor, Geely, Hongqi and NIO quicken their pace of applying HUDs in their vehicles, and lower their prices to the range of RMB100,000 to RMB150,000. Third, the production-ready AR-HUD will boom in the 3 or 5 years to come.



Abstract

OEMs work hard on W-HUD and push on with increasing installations.

At present, W-HUD as the mainstream solution of automakers is encroaching on the C-HUD market. Our data show that in 2020, W-HUD swept 91.8% of total HUD installations, up 10.2 percentage points year on year. As the technology matures, AR-HUD, which has become available on market in small batches from 2021, will be neck and neck with W-HUD, together driving up HUD installations.

In future, W-HUD will evolve from an optional configuration for high-class vehicles to a standard one for medium & low class. Chinese auto brands play a crucial role in this process. Since 2020, the likes of Hongqi, Haval, Geely, Lynk & Co and Geometry have been the main drivers of W-HUD in China. The prices of HUD-enabled models like Geely Preface, Haval Big Dog and Haval First Love have been lowered to RMB150,000.

Installation of HUD in 2021 Models of Main Brands

	Brand	Model	Price (RMB1,000)	Low Configuration	Medium Configuration	High Configuration
Chinese	Hongqi	EHS9	>500	/	/	AR
	Haval	Big Dog	100-200	W	W	W
	Haval	First Love	0-150	/	/	W
	WEY	Mocha	150-250	W	W/AR	AR
	Geely	Preface	100-200	/	/	W
	Lynk & Co	05	200-250	/	/	W
Joint Venture	Toyota	Camry	150-300	W	W	W
	Buick	GL8	200-550	/	W	W
	BMW	3 Series	250-500	W (optional)	W (optional)	W
	Honda	CR-V	150-300	/	C	C
	Volkswagen	ID.4X	150-300	/	AR	AR

Note: C/W/AR refers to C-HUD/W-HUD/AR-HUD; "/" means no installation.
Source: ResearchInChina

Abstract

Mass production of AR-HUD starts, and TFT solution becomes the first choice.

AR-HUD displays real road conditions. The combination of ADAS functions such as LKA and ACC provides immersive experience for drivers, which is a future trend for HUD.

In September 2020, Mercedes-Benz S-Class with AR-HUD made a debut, establishing the age of mass-produced AR-HUD. And then models including Audi Q4 e-tron, Volkswagen ID Series, FAW Hongqi and Great Wall WEY have been competing to offer AR-HUD-enabled versions.

In addition, Hyundai Kia, Hyundai Aini Krypton, GAC, Changan Auto and Chery, among others, plan to equip their new cars with AR-HUD. For example, AR-HUD co-developed by GAC and Foryou Group is to be first mounted on a mass-produced model in the fourth quarter of 2021.

Through the lens of solutions, AR-HUDs spawned so far generally use TFT and DLP technologies. By comparison, TFT costs less so Chinese models prefer this technology; despite high cost, DLP technology that works very well finds application in some highly-configured or top-class models (e.g., Mercedes-Benz S-Class with selling price higher than RMB800,000).

Comparison of AR-HUD Solutions for Mass-produced Models

Launch Time	Model	Solution	Projection Distance (m)	Projected Image (inches)	Supplier
Dec. 2020	Hongqi E-HS9	TFT	7.5	44	Crystal-Optech
Jan. 2021 (China)	Mercedes-Benz S-Class	DLP	10 or so	77	Nippon Seiki
Jan. 2021(China)	Volkswagen ID.4	TFT	10 or so	70.9	LG
May 2021	WEY Mocha	TFT	13	75	Hitachi

Source: ResearchInChina

WEY Mocha: launched in May 2021, the model carries AR-HUD which delivers 13m projection distance and 75-inch image where speed, fuel level, distance (to destination), direction, etc. are shown. The device also enhances annotations to lane lines and displays the dynamic distance with other vehicles, with dynamic arrows appearing for guidance when turning or U-turning.

WEY Mocha AR-HUD Rendering

Source: Great Wall Motor

Volkswagen: the automaker has rolled out several AR-HUD-enabled models such as ID.4 and ID.6 since 2021, all of which use TFT projection technology. Differing from WEY Mocha and other China-made cars, these Volkswagen models feature double-layer display design in which the upper layer is AR field where driving assistance information and navigation tips are displayed in the form of dynamic 3D rendering, with virtual image distance (VID) up to 10m and display field diameter of 1.8m (about 70.9 inches); the lower layer is status field displaying speed, navigation, road signs, destination, etc., with VID of 3m.
Things come in pairs. Both Mercedes-Benz and Audi also adopt such display design, which makes images enhanced in much better virtual effects.

Volkswagen AR-HUD Rendering

Source: Volkswagen

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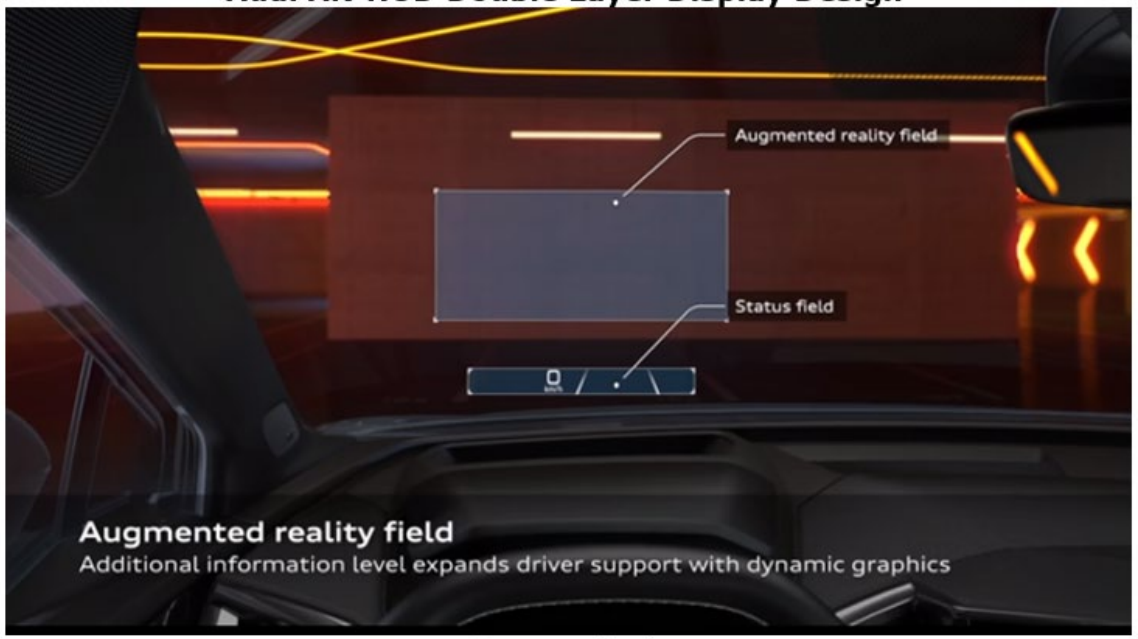
Audi AR-HUD Double Layer Display Design



Source: Audi

The rising Chinese suppliers pin great hope on AR-HUD.
Nippon Seiki, Denso and Continental have a monopoly on the Chinese HUD market. They target mid- and high-end brands such as BMW, Audi, Mercedes-Benz, Mazda, Toyota, Honda and Buick.

In China, local suppliers like Foryou Multimedia Electronics, Jiangsu New Vision Automotive Electronics and E-Lead Electronic serve domestic automakers including Geely, Hongqi, Great Wall Motor, NIO and Dongfeng Motor.

As AR-HUD comes into being, almost all suppliers gravitate towards it, but local players are more motivated.
Nippon Seiki: the world's largest HUD supplier boasts annual capacity of nearly 2 million units. In 2020, it was the first one to provide AR-HUD for Mercedes-Benz S-Class. In 2021, it is working hard on construction and layout of HUD production bases in China.
Foryou Multimedia Electronics: as of June 2021, the supplier has shipped a total of 200,000 HUDs which have been used in multiple models of Great Wall Motor, GAC, BAIC, Dongfeng Nissan and Changan Auto. The company has secured designated AR-HUD projects from GAC and others that plan installation in their vehicles in 2021. It is also developing double layer AR-HUD, with the maximum and minimum VID up to 10m and 2.4m, respectively.
Huawei: in April 2021, Huawei unveiled an AR-HUD based on LCOS projection technology, offering 7.5m VID, 13°x 5° FOV and 70-inch image. The device is just 10L much smaller than DLP HUD, and puts projections directly onto the windshield, with no need for special treatment of the windshield.

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AR-HUD Layout of Local HUD Suppliers in China

Supplier	PGU Solution	AR-HUD Layout
Foryou Multimedia Electronics	DLP/TFT	Develop DLP and TFT AR HUD solutions simultaneously, plan to launch with supported models in 2021H2 (the VID of DLP solution is up to 10m; the projection distance of TFT solution becomes increasingly longer with technology upgrade).
Jiangsu New Vision Automotive Electronics	TFT	Secured a designated project from an automaker, planned SOP in 2022; development of its first 1.5-generation PGU (dual-screen solution) together with Sunny Optical Technology.
Futurus Technology	TFT	In cooperation with BMW, it has carried out actual vehicle tests and plans to implement in 2022; it has also developed full-window display and light field display technologies.
Beijing ASU Tech	LCOS+laser	Launched an AR-HUD solution based on LCOS laser projection technology in 2020, team up with 3 OEMs for testing in 2021, and to mass-produce in 2022H2; meanwhile, pre-develop optical waveguide AR-HUD.
Raythink	OpticalCore® Patented Optical Core Engine Technology	In 2020, launched Tri-Lane AR-HUD and Mono-Lane Plus AR-HUD, and partnered with Aptiv for planned mass production during 2022-2023.
Huawei	LCOS	In April 2021, launched an AR-HUD based on LCOS technology, with volume of only 10L, FOV of 13°x 5°, and VID of 7.5m, and demonstrated it on Hongqi EHS9.
Shenzhen Jiangcheng Technology	TFT	Co-developed with AUTOAI and BOE, with volume of about 7.5L and the VID of over 8m.
Crystal-Optech	TFT	Small batch production in 2020, mounted on Hongqi E-HS9, with projection area of 44 inches, FOV of 120°*3° and VID of 7.5m.
Yesar Technology	DLP	Under development, demonstrated in 2017
Carpro	TFT	Developed standard AR-HUD (entry level) for an automaker; developing large-screen AR-HUD technology.

Source: ResearchInChina

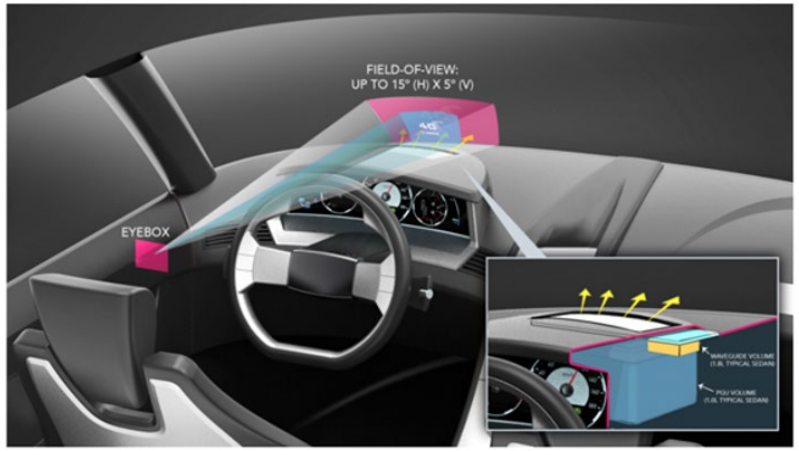
Giants race to deploy new-generation holographic technology.

Current mass-produced AR-HUDs still adopt the geometrical optical projection solution that W-HUD uses, which means an ultra-large aspheric mirror is needed to increase the projection distance (AR-HUD VID is required to be over 10m). Thus the package size is so large that OEMs cannot use.

Holographic technology (optical waveguide, HOE, CGH, etc.) which not only reduces the size of the device but widens FOV has been a hot spot for suppliers and automakers.

In Sept. 2020, DigiLens, an optical waveguide start-up, 18% owned by Continental, introduced its CrystalClear? AR HUD based on DigiLens' proprietary photopolymer material, with the largest FOV up to 15°x5°, luminance of 12,000 nits and package size of just 5 liters, allowing it to fit into most vehicles and displaying images at infinity.

Holographic Displays that Seamlessly Integrate into Standard Windshields



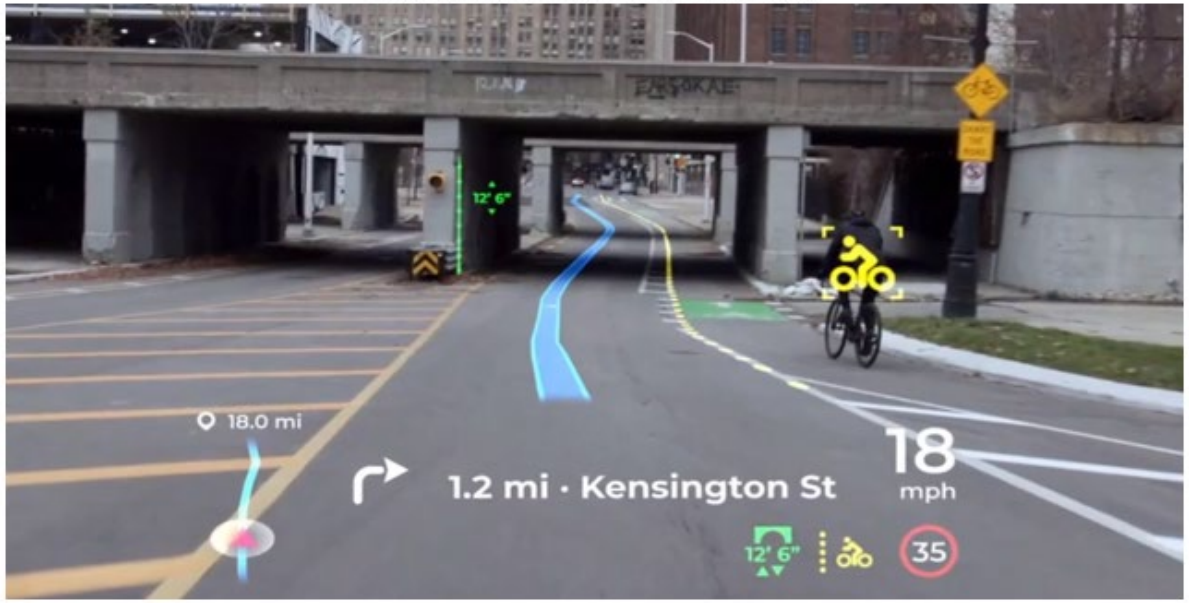
Source: DigiLens

Abstract

In January 2021, Panasonic together with Envisics rolled out an AR-HUD based on laser holographic technology. Using eye tracking and vibration control technologies, the HUD offers VID up to 10m, FOV of 10°×4°, and image resolution as high as 4K, displaying speed, fuel level, etc. in the near field and navigation in the far field.

Envisics, founded in 2018 and based in the UK, is developing holographic AR-HUD for over ten companies such as Hyundai Mobis, General Motors and SAIC. Its new technology will be the first used in Cadillac's mass-produced models in 2023.

New-generation Laser Holographic AR-HUD Jointly Released by Panasonic and Envisics



Source: Panasonic

In July 2021, VividQ, a computer-generated holographic technology (CGH) firm, raised USD15 million in its seed funding round led by UTokyo IPC, the venture investment arm for the University of Tokyo. Its holographic technology will be first applied to automotive HUD for OEMs in China in early 2022.

Moreover, Hyundai/Porsche (investing WayRay), Denso/Intel (investing CY Vision) and BAIC (partnering with Sanji Optoelectronics) are deploying holographic technology as well.

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