
INDUSTRY OVERVIEW

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OVERVIEW OF GLOBAL PRECISION OPTICAL SOLUTIONS INDUSTRY

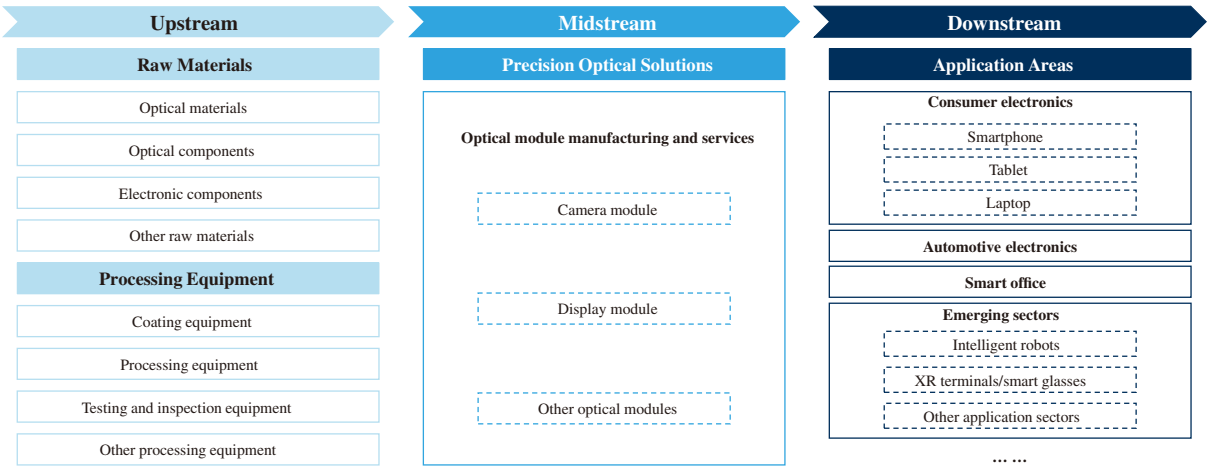
Precision optical solutions refer to integrated solutions provided based on optical modules that leverage high-precision optical design, manufacturing and testing technologies. These solutions cover multiple categories of products, including camera modules and display modules, and are widely applied in scenarios such as perception, imaging, ranging and display. Precision optical solutions are a key support for the development of industries such as consumer electronics, automotive electronics, smart office, emerging sectors (such as intelligent robots and XR smart devices, smart glasses, naked-eye 3D products, holographic projection, and immersive displays), and are of critical importance to enhancing system performance, ensuring operational stability and driving technological innovation.

The rapid development of AI technology places higher requirements on optical modules, requiring the delivery of higher resolution, stronger perception capabilities, and lower power consumption to meet smart devices’ demands for precise sensing, real-time analysis, and adaptation to complex environments. As a result, optical modules are evolving from traditional sensing and imaging functions toward the integration of intelligent perception and computational optics, providing critical support for the continuous upgrade of AI hardware. At the same time, the introduction of AI significantly enhances the intelligence of image processing and interaction, accelerates the adoption of cross-scenario applications, and drives the demand upgrade and industrial expansion of precision optical solutions. AI is also streamlining optical manufacturing by improving process automation and quality control, enabling faster iteration and more consistent production of high-precision components essential for AI hardware.

The following chart demonstrates the different roles along the upstream, midstream and downstream segments of the industry chain. Leading players leverage vertical integration capabilities to build integrated solutions covering the entire industry chain of precision optics, from core components, optical components and optical modules to system integration.

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Industry Chain of Global Precision Optical Solutions Industry



Source: Frost & Sullivan

OVERVIEW OF GLOBAL CONSUMER ELECTRONICS PRECISION OPTICAL SOLUTIONS INDUSTRY

Consumer electronics precision optical solutions are integrated solutions provided with optical modules as the core, combining high-precision design, manufacturing and testing capabilities. These solutions cover products such as camera modules and display modules, which enable devices such as smartphones, tablets and laptops to achieve functions including image acquisition, environmental perception and interactive display.

Consumer electronics precision optical solutions can be applied to various fields such as smartphones, tablets and laptops to meet different functional and environmental requirements. Driven by AI, traditional imaging and display functions are further extended toward computational photography, intelligent perception, and multi-modal interaction. The introduction of AI has further enhanced recognition accuracy and the intelligence level of interactions, driving the differentiated development of precision optical solutions across different smart devices.

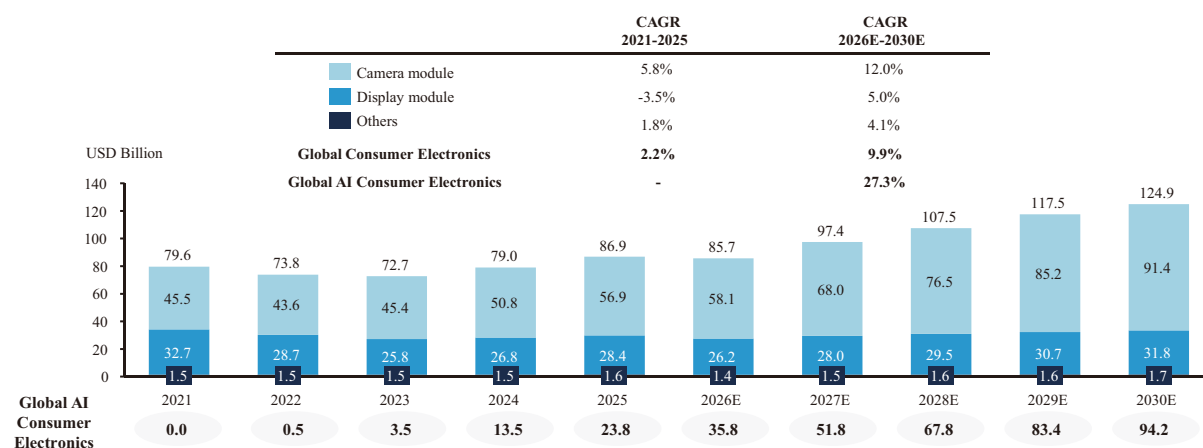
Market Size Analysis of Global Consumer Electronics Precision Optical Solutions Industry

Consumer electronics precision optical solutions are the core support for consumer electronics smart devices to achieve high-quality imaging, interactive perception and differentiated experience. The global consumer electronics precision optical solutions market contracted from approximately US\$79.6 billion in 2021 to approximately US\$72.7 billion in 2023, resulting from the global economic slowdown and weakening demand for consumer electronics. With the accelerated adoption of next-generation optical technologies such as AI-powered imaging algorithms and multi-camera integration, the market rebounded, reaching approximately US\$86.9 billion in 2025, representing a CAGR of 2.2% from 2021 to 2025. Driven by the upgrade of imaging experience of consumer electronics smart devices and the expansion of application of optical innovations, the size of the global consumer electronics precision optical solutions market is expected to reach US\$124.9 billion by 2030, representing a CAGR of 9.9% from 2026 to 2030.

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AI has become the core growth driver of the global consumer electronics precision optical solutions market. With the rapid shipment growth of AI smartphones, AI tablets, and AI laptops, optical modules are increasingly empowered with computational photography, intelligent perception, and immersive interaction functions, driving both market value and technical complexity upward. By 2030, the size of the global precision optical solutions market applied in AI consumer electronics is expected to reach approximately US\$94.2 billion, representing a CAGR of 27.3% from 2026 to 2030.

Market Size of Global Consumer Electronics Precision Optical Solutions Industry by Revenue, 2021–2030E



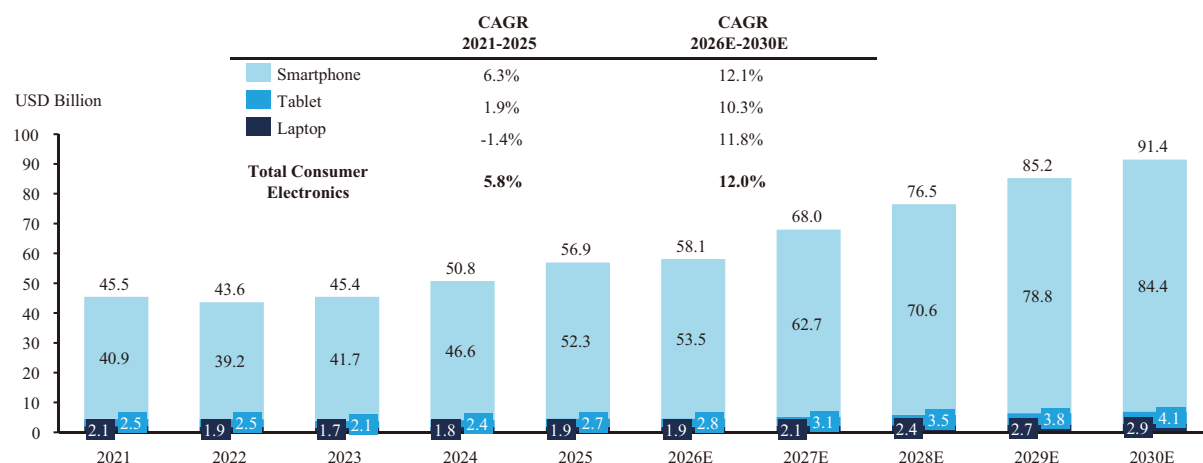
Source: Frost & Sullivan

Consumer electronics camera modules, as a key component of precision optical solutions, are widely applied in consumer electronics products such as smartphones, tablets and laptops. In 2021, the size of the global consumer electronics camera modules market was approximately US\$45.5 billion, and declined to US\$43.6 billion in 2022, affected by fluctuations in consumer electronics smart device demand; since 2023, driven by the multi-camera trend, image algorithm upgrades, and the increasing adoption of AI vision functions as standard features, the market has resumed growth, reaching US\$56.9 billion in 2025, representing a CAGR of 5.8% from 2021 to 2025. The size of the global consumer electronics camera modules market is expected to reach US\$91.4 billion by 2030, representing a CAGR of 12.0% from 2026 to 2030.

Smartphones remain the largest application market for camera modules, accounting for over 90% in 2025, followed by tablets and laptops, accounting for approximately 4.8% and 3.4%, respectively. Looking ahead, benefiting from the adoption of AI applications and driven by the demand for remote work and education, the tablet and laptop markets have put forward higher requirements on the experience of 3D imaging, facial recognition and video conferencing, which is driving the penetration of high-resolution and multi-functional camera modules, leading to CAGRs of 10.3% and 11.8% in their overall market size, respectively.

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Market Size of Global Consumer Electronics Camera Module Industry by Revenue, 2021–2030E



Source: Frost & Sullivan

Analysis of Driving Factors and Development Trends of Global Consumer Electronics Precision Optical Solutions Industry

Upgrading demand for smartphone functions

The continuous iteration of smartphones drives precision optical solutions to develop towards high-resolution, multi-lens and intelligence. Taking smartphone camera modules as an example, the penetration rate of global smartphone camera modules with 48-megapixel and above is expected to reach over 50% by 2030. Among them, periscope telephoto lenses, with higher optical zoom capability and structural advantages, have become one of the key configurations for imaging upgrade of high-end models, significantly enhancing imaging and spatial perception capability. At the same time, the rapid adoption of AI smartphones has further accelerated this trend. The global shipment volume of AI smartphones is expected to exceed one billion units by 2030. With AI algorithms optimizing image processing, high-resolution, multi-lens and intelligent configurations are becoming mainstream standards for smartphones.

Consumers' demand for composite imaging functions such as high-definition imaging, night mode shooting and wide-angle/telephoto functions has driven smartphones into a stage of rapid iteration, continuous innovation and diversification. Leading consumer electronics precision optical solutions providers keep pace with critical trends of market demand, continuously optimizing technologies such as image algorithms, hardware architecture and AI imaging processing capability to ensure product quality and scenario adaptability while maintaining their leading positions.

Intelligent manufacturing driving technology evolution and industry upgrade

The requirements of smart device application markets on the heat resistance, impact resistance and reliability of camera modules are continuously increasing, driving ongoing innovation on the materials side. Leading enterprises have established adhesive R&D laboratories, conducted in-depth research on material performance, and precisely addressed industry pain points such as lens detachment, so as to ensure the stable operation of complex modules under extreme environments.

Against the backdrop of accelerating product iteration and deepening customization of smart device demand, industry manufacturing is shifting from traditional experience-based to algorithm-driven and intelligent processes. Leading enterprises have independently developed multi-group AA process algorithms and optical module simulation systems, and are one of the few companies to simultaneously

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master both COB and flip chip processes. Through the synergy of core algorithms and processes, they achieve efficient, flexible and precise module manufacturing, meeting the diversified customization needs of different smart device brands.

Emerging optical imaging technologies enhancing product value

Functions such as 3D imaging, ToF in-depth sensing, facial recognition and AI vision optimization are rapidly adopted in consumer electronics smart devices at an accelerated pace, driving traditional imaging devices to upgrade into multi-functional sensors to provide consumer electronics smart devices with greater interactive and perception capabilities. At the same time, emerging optical imaging technologies such as continuous zoom, glass-plastic hybrid and variable aperture are making continuous breakthroughs, further enhancing the unit value of optical modules through optical design, optical path optimization and AI algorithm synergy.

Leading consumer electronics precision optical solutions providers are enhancing the overall performance and added value of modules by optimizing optical design, strengthening AI algorithm capabilities and improving naked-eye 3D display technology, thereby helping smart device manufacturers build differentiated selling points in imaging systems and driving the transformation and upgrade of optical modules towards technology integration and functional innovation.

Analysis of the Competitive Landscape of Global Consumer Electronics Precision Optical Solutions Industry

In 2025, the market size of the global consumer electronics camera module industry reached approximately US\$56.9 billion. By 2025 revenue, the top five global consumer electronics camera module providers had a combined market share of 37.7%, indicating a relatively fragmented market. Among them, we recorded revenue of US\$4.4 billion from global consumer electronics camera module industry in 2025, ranking second globally and first among China-based companies, with a market share of 7.7%.

Ranking of Global Consumer Electronics Camera Module Industry by Revenue, 2025

Ranking	Company Name	Revenue (US\$ billion)	Market Share (%)	Headquarter
1	Company A	10.0	17.6%	Korea
2	Our Group	4.4	7.7%	China
3	Company B	3.3	5.7%	China
4	Company C	2.1	3.8%	China
5	Company D	1.6	2.9%	China
Top Five		21.4	37.7%	
Total		56.9		

Source: Frost & Sullivan

In 2025, the market size of global smartphone camera module industry reached approximately US\$52.3 billion. By 2025 revenue, the top five global smartphone camera module providers had a combined market share of 37.1%, indicating a relatively fragmented market. Among them, we recorded revenue of US\$3.5 billion from the global smartphone camera module industry in 2025, ranking second globally and first among China-based companies with a market share of 6.7%. At the same time, we recorded revenue of US\$3.4 billion from global mid- to high-end smartphone camera module industry in 2025, ranking second globally and first among China-based companies, with a market share of 7.4%.

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Smartphone camera module industry has undergone multiple rounds of technological iteration and cost competition, with the competitive landscape continuously evolving. In the early stage, industry was participated by numerous small- and medium-sized manufacturers; with the popularization of high-barrier technologies such as dual-camera, multi-camera, high-resolution and optical image stabilization, the industry concentration has significantly increased, showing a trend of the strong becoming stronger. In recent years, leading enterprises have continuously consolidated their advantageous positions by investing in automated production that enhance production efficiency and AI algorithms that optimize image processing, as well as upgrading their customer structure and global layout, while the industry has accelerated reshuffling, with manufacturers that lack scale and technological advantages facing elimination pressure. Mergers and acquisitions have become an important trend, and leading enterprises have vertically integrated resources, expanded product portfolios through acquisition, and cultivated AI-enabled intelligent imaging capabilities, demonstrating forward-looking strategic vision and synergy effects.

Ranking of Global Smartphone Camera Module Industry by Revenue, 2025

Ranking	Company Name	Revenue (US\$ billion)	Market Share (%)	Headquarter
1	Company A	9.5	18.2%	Korea
2	Our Group	3.5	6.7%	China
3	Company B	3.0	5.7%	China
4	Company C	1.9	3.6%	China
5	Company D	1.5	2.9%	China
Top Five		19.4	37.1%	
Total		52.3		

Source: Frost & Sullivan

Ranking of Global Mid- to High-End Smartphone Camera Module Industry by Revenue, 2025

Ranking	Company Name	Revenue (US\$ billion)	Market Share (%)	Headquarter
1	Company A	9.5	20.7%	Korea
2	Our Group	3.4	7.4%	China
3	Company B	2.5	5.5%	China
4	Company C	1.6	3.5%	China
5	Company D	1.3	2.8%	China
Top Five		18.3	39.9%	
Total		45.8		

Source: Frost & Sullivan

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In 2025, the market size of the global laptop camera module industry reached approximately US\$1.9 billion. Our Group recorded revenue of US\$0.3 billion from the global laptop camera module industry in 2025, ranking first with a market share of 16.0%. In 2025, the market size of the global tablet camera module industry reached approximately US\$2.7 billion. Our Group recorded revenue of US\$0.6 billion from the global tablet camera module industry in 2025, ranking first with a market share of 22.1%.

Notes:

1. Company A was established in 1970 and is listed on the Korea Exchange. It is primarily engaged in the manufacturing of camera modules, substrates, LEDs, automotive sensors and lighting components.
2. Company B was established in 2006 and is listed on the Hong Kong Stock Exchange. It is primarily engaged in the manufacturing of optical components and precision modules, covering smartphone lenses, in-vehicle lenses, and XR optical modules.
3. Company C was established in 2014 and is listed on the Hong Kong Stock Exchange. It is primarily engaged in the design, R&D and manufacturing of high-performance camera modules and fingerprint recognition modules, which are applied in mobile phones, automobiles, smart homes and drones.
4. Company D was established in 2001 and is listed on the Shenzhen Stock Exchange. It is primarily engaged in the manufacturing of touch screen modules, camera modules and fingerprint recognition modules, which are widely applied in mobile phones and automobiles.

OVERVIEW OF GLOBAL AUTOMOTIVE ELECTRONICS PRECISION OPTICAL SOLUTIONS INDUSTRY

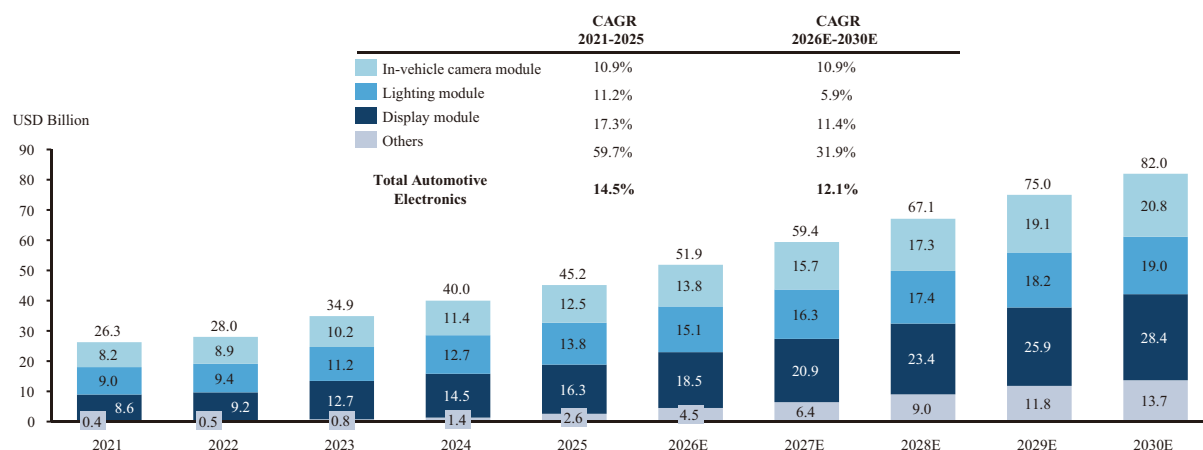
Automotive electronics precision optical solutions are integrated solutions provided with optical modules as the core, combining high-precision design, manufacturing and testing capabilities. These solutions cover products such as in-vehicle camera modules, lighting modules, window projection modules, display modules, and HUD optical modules, which enable vehicles to achieve functions including environmental perception, intelligent lighting, cockpit display and human-machine interaction. Among them, AI technology deeply empowers optical modules, enabling real-time object recognition, driving behavior prediction, dynamic lighting adjustment, augmented reality navigation, and intelligent cockpit interaction through multi-sensor fusion, computer vision, deep learning, and scene-understanding algorithms. This significantly enhances vehicle performance and user experience in advanced driver-assistance systems (ADAS), intelligent cockpit, and safety assurance, making it a key technological pillar for core perception and interaction in smart vehicles.

Market Size Analysis of Global Automotive Electronics Precision Optical Solutions Industry

Automotive electronics precision optical solutions are at the core of enabling functions such as intelligent driving and intelligent cockpits, and determining vehicle safety, automation level and user experience. The size of the global automotive electronic precision optical solutions market increased from approximately US\$26.3 billion in 2021 to approximately US\$45.2 billion in 2025, representing a CAGR of 14.5% from 2021 to 2025; with the continuous increase in the penetration rate of autonomous driving and the upgrade of in-vehicle imaging systems from single imaging to multi-functional perception, it is expected to reach US\$82.0 billion by 2030, representing a CAGR of 12.1% from 2026 to 2030.

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Market Size of Global Automotive Electronics Precision Optical Solutions Industry by Revenue, 2021–2030E



Source: Frost & Sullivan

As the core perception component of intelligent driving systems, global in-vehicle camera modules are widely applied in scenarios such as front view, rear view, surround view, side view and in-vehicle monitoring. The size of the global in-vehicle camera module market reached approximately US\$8.2 billion in 2021. Driven by increased penetration of autonomous driving, the expansion of L2+ and above autonomous driving configurations and regulatory policy support, the market is experiencing rapid growth. The global in-vehicle camera module market reached US\$12.5 billion in 2025, representing a CAGR of 10.9% from 2021 to 2025. As in-vehicle vision systems evolve from assistance to decision-making perception, and as intelligent in-cabin applications such as driver monitoring system (DMS) and occupant monitoring system (OMS) rapidly gain adoption, the global in-vehicle camera module market is projected to reach US\$20.8 billion by 2030, representing a CAGR of 10.9% from 2026 to 2030.

Analysis of Driving Factors and Development Trends of Global Automotive Electronics Precision Optical Solutions Industry

The penetration of autonomous driving leading to a significant increase in the quantity and quality of solutions

The global penetration rate of L2+ and above autonomous driving models is expected to increase from approximately 40.0% in 2026 to over 70.0% in 2030. As autonomous driving expands from highways to complex urban traffic scenarios, the industry demand for optical solutions in terms of accuracy, response speed and reliability has increased significantly; high-performance camera modules have become core components to ensure vehicles' real-time perception of pedestrians, obstacles, lanes and traffic signals.

Automotive electronics precision optical solutions must ensure stable operation in all weather conditions, under varying lighting conditions, and in complex environments. They must also support key functions such as driver monitoring and passenger safety monitoring, driving continuous technology iteration and value-added enhancement in the industry, providing key support for safe and reliable intelligent driving.

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Multi-functional Integrated Solutions Enhancing Intelligent Cockpit Experiences

With the rise of intelligent cockpits, DMS and OMS systems have rapidly gained widespread adoption. Features such as infrared night vision, head recognition, and behavior tracking demand high-precision, highly reliable, and multifunctional integrated optical solutions for fatigue detection, child left-behind alerts, and critical safety scenario monitoring. At the same time, the continuous evolution of ADAS drives the integration of in-vehicle and external perception capabilities. The safety and interaction requirements of intelligent cockpits are simultaneously improved, which drives the development of optical modules towards higher precision and greater environmental adaptability.

In-vehicle entertainment and interaction demands are also driving the upgrade in optical technology applications. Integration of features like gesture control, AR heads-up displays and in-vehicle interactive entertainment systems enables passengers to enjoy immersive experiences through natural interactions. Precision optical solutions continue to expand their applications within intelligent cockpits, covering functions such as in-vehicle monitoring, gesture recognition, driving behavior analysis and interactive entertainment. Leading companies enhance overall performance and added value by optimizing optical module design, improving algorithm capabilities and advancing multi-functional integration, thereby creating safe, intelligent and differentiated in-vehicle experiences.

Industry Collaboration Driving the Platform-based Evolution of Solutions

The centralized electronic and electrical architecture of the next-generation intelligent vehicles places higher performance demands on the entire vehicle’s perception system, driving the evolution of automotive electronic precision optical solutions from single perception components to comprehensive platforms with data processing, edge computing, AI algorithms and system collaboration capabilities. By leveraging AI algorithms to optimize perception accuracy and response speed, the response speed, accuracy, and reliability of optical solutions in autonomous driving and intelligent cockpit scenarios are significantly enhanced, becoming the core support for vehicle intelligence.

To meet the demand for high-performance optical solutions under the centralized architecture, consumer electronics precision optical solutions providers are accelerating their entry into the automotive electronics market. Relying on mature automated packaging production lines, batch optical calibration capabilities and synergy from simultaneous manufacturing of optical devices, they achieve cost optimization, yield rate improvement and rapid mass production, becoming important partners for downstream customers, including vehicle manufacturers, in improving manufacturing efficiency and rapidly scaling up production.

OVERVIEW OF GLOBAL SMART OFFICE PRECISION OPTICAL EQUIPMENT INDUSTRY

Smart office equipment serves as the foundational hardware for modern enterprises to build efficient collaboration and information processing systems, covering critical processes such as document capture, recognition, transmission and management. Among them, smart printers and scanners, as key smart devices that embody the core capabilities of image capture and processing, have become the direct and extensive carriers of optical technology in smart office scenarios. As office settings shift from centralized workplaces to remote collaboration and mobile office, higher requirements are placed on the optical performance of equipment such as imaging accuracy, recognition accuracy, and response speed, further promoting the continuous upgrading of precision optical solutions in printing and scanning.

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Market Size Analysis of Global Smart Printer and Scanner Industry

As global enterprises move toward smart office work, smart printers and scanners are undergoing a transformation toward integration and intelligence upgrades. Continuous advancements in optical technology, in particular, have driven functional diversification and performance optimization. Leveraging high-precision optical modules, smart printers and scanners now enable faster, clearer image capture and processing, supporting emerging applications such as secure printing, remote management, and document digitization. The global smart printer and scanner market reached approximately US\$13.7 billion in 2021. Benefiting from the rise of remote work and the upgrade of demands for enterprise document management, the size of the global smart printer and scanner market increased to US\$17.5 billion in 2025, representing a CAGR of 6.2% from 2021 to 2025. With the accelerated adoption of technologies such as AI document recognition, cloud print management and energy-efficient printing, it is expected to reach approximately US\$25.3 billion by 2030, representing a CAGR of 7.7% from 2026 to 2030.

Analysis of Driving Factors and Development Trends of Global Smart Office Precision Optical Equipment Industry

Precision Optical Technology Becoming the Core Driving Force for the Upgrade of Smart Office Devices

As office scenarios evolve from traditional centralized setups to remote collaboration and mobile work, core hardware such as smart printers and scanners face higher demands for image capture, recognition accuracy, and processing efficiency. High-end intelligent office devices, such as high-speed smart printers and large-volume document scanners, must meet requirements for fast, high-precision processing while ensuring long-term operational stability and low failure rates. This imposes more stringent challenges on optical components, algorithm optimization, thermal management, and system integration capabilities. Compared with mid- to low-end products, R&D and mass production of such high-end devices become key technological barriers and competitive advantages in the industry, simultaneously driving the continuous upgrading of precision optical technology and enhancing resolution, response speed, and integration in intelligent office equipment.

AI and IoT Technologies Empowerment Enhancing Device Intelligence and User Experience

High-end precision optical technology is extending from consumer electronics to key aspects of smart offices, becoming the core technology that supports the intelligence and efficiency enhancement of office equipment. Smart office equipment, especially smart printers and scanners, use AI and IoT technologies to enable voice control, face recognition, gesture operation and automatic file management, thereby improving the level of office automation and user interaction experience. AI algorithms can intelligently predict and optimize based on user behavior and usage scenarios, such as automatically adjusting parameters, recognizing document types, and optimizing task scheduling, thereby further enhancing device efficiency and operational convenience. At the same time, cloud platforms enable remote device management, data security, and real-time monitoring, further optimizing workflows, enhancing data compliance, and delivering overall efficiency improvement for enterprises.

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Leading Consumer Electronics Precision Optical Solutions Providers Building First-mover Advantage

In the future, smart office devices are expected to evolve towards intelligent interconnection, cloud collaboration, and AI empowerment. Leading consumer electronics precision optical solutions providers are leveraging their mature hardware foundation to expand into the field of smart office system integration, building end-to-end manufacturing capabilities from core components and functional modules to system integration of devices, thereby opening up new avenues for business growth and enhancing their influence in the industry chain.

OVERVIEW OF GLOBAL PRECISION OPTICAL SOLUTIONS INDUSTRY IN EMERGING SECTORS

With the continuous iteration of AI technology, AI hardware forms are becoming increasingly diverse, and new-generation products are being rapidly introduced to the market. The deep integration of intelligent hardware and AI algorithms enables precision optical solutions in AI hardware to perform core functions such as perception, 3D imaging, real-time analysis, and environmental reconstruction, enhancing human-machine interaction and virtual/augmented reality experiences. These solutions also support applications such as intelligent navigation, remote monitoring, environment recognition, and behavior analysis, bringing breakthroughs to smart city construction, medical rehabilitation, educational innovation, and everyday home life. Trends toward miniaturization, low power consumption, and high integration in optical systems are accelerating, with wearable smart devices, pocket-sized smart devices, and holographic projection devices gradually becoming more widespread, delivering unprecedented immersive interactive experiences and driving cross-industry innovation in ecosystems, algorithms, and business models.

Intelligent robots, XR smart devices, and smart glasses have already emerged as leading large-scale application scenarios, driving the industry’s expansion from traditional industrial and consumer electronics toward smart cities, healthcare, education and training, intelligent offices, and diversified lifestyle services. This, in turn, is accelerating the advancement of precision optical solutions in high-resolution imaging, depth perception, environmental understanding, and multi-modal interaction.

Precision optical solutions for intelligent robots center on optical modules, combined with high-precision design, manufacturing, and testing capabilities, providing comprehensive solutions including cameras and display modules. These enable robots to achieve environmental perception, human-machine interaction, and precise operation. As robots evolve toward humanoid intelligence, optical solutions leverage AI algorithms to support object recognition, motion prediction, gesture recognition, and multi-modal environmental understanding, significantly enhancing adaptive capabilities and decision-making intelligence in dynamic environments. High-resolution imaging, depth perception, and algorithmic synergy are key factors in improving product intelligence, market differentiation, and competitiveness.

Precision optical solutions for XR smart devices and smart glasses include camera modules, waveguides, and micro-display optics, supporting immersive experiences, spatial perception, and real-time information display. XR smart devices are widely applied in gaming, industrial training, and remote collaboration; lightweight smart glasses are gradually becoming more common in daily life. Through AI computation, depth perception, and multi-sensor fusion, these optical solutions enable scene understanding, object recognition, and real-time feedback, greatly enhancing device intelligence, lightweight design, and immersive interaction, thereby accelerating deployment and adoption across diverse scenarios.

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Market Size Analysis of Global Precision Optical Solutions Industry in Emerging Sectors

Amidst expanding demands in smart manufacturing, intelligent logistics, home services, and smart security, the intelligent robots market is experiencing accelerated growth, driving a rapid rise in demand for precision optical solutions. The size of the global intelligent robots precision optical solutions market reached approximately US\$3.3 billion in 2021. It increased to US\$6.8 billion in 2025, representing a CAGR of 20.3% from 2021 to 2025, and is expected to reach US\$18.9 billion by 2030, representing a CAGR of 22.4% from 2026 to 2030.

Driven by accelerated investments from consumer electronics giants and expanding downstream applications, global shipments of XR smart devices and smart glasses are growing rapidly, simultaneously boosting demand for precision optical solutions. High-value-added products, particularly high-performance front-facing tracking cameras, environmental perception ToF modules and eye-tracking IR modules, have emerged as the focus for the latest technological upgrade. The size of the global precision optical solutions market in XR smart devices and smart glasses grew from approximately US\$0.8 billion in 2021 to approximately US\$2.2 billion in 2025, representing a CAGR of 28.7% from 2021 to 2025. It is projected to reach US\$19.3 billion by 2030, representing a CAGR of 55.4% from 2026 to 2030.

Analysis of Driving Factors and Development Trends of Global Precision Optical Solutions Industry in Emerging Sectors

Multi-Scenario Intelligent Deployment Driving Module Upgrade

The rapid development of intelligent service robots, industrial robotic arms, and humanoid robots across diverse applications has raised the requirements for perception capabilities, driving precision optical solutions toward high-resolution, multi-modal fusion, real-time sensing, and AI processing integration. These upgrades support complex task execution, dynamic environment recognition, and natural human-machine interaction. Humanoid robots are expected to become a core incremental scenario, with the global market projected to reach approximately US\$15.8 billion by 2030. This growth drives technical demands for gesture recognition, facial recognition, and depth measurement, further stimulating demand for high-performance optical modules.

XR smart devices are accelerating penetration into gaming, virtual social interaction, and remote collaboration, imposing higher requirements on optical modules for real-time capture accuracy, environment perception, and user interaction. Features such as high-definition image capture, low-latency tracking, and spatial positioning are becoming standard features of XR smart devices, driving module technology upgrades. As lightweight wearable devices, smart glasses are evolving toward comfort and all-day wear, meeting diverse usage scenarios including work, travel, sports, and information access. With over 2 billion people globally affected by myopia, most relying on traditional glasses for vision correction, smart glasses benefit from a natural user base. Deep integration of AI technology in optical modules enables intelligent scene recognition, real-time image enhancement, multi-modal interaction, and user behavior prediction, enhancing immersive experiences and promoting the transition of high-end devices toward mass adoption.

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Emerging AI Hardware Shaping a New Industry Landscape

New-generation AI hardware, including wearable devices, pocket-sized smart terminals, and holographic projection products, is advancing rapidly. As existing application scenarios demand higher-performance iteration, these devices increasingly rely on optical perception as the essential channel for information collection and user interaction. With deep learning, 3D perception, and semantic understanding, they deliver real-time capture, environment modeling, and natural interaction, while diverse form factors continue to drive steady demand for precision optical solutions. Higher requirements for resolution, latency, multi-modal fusion, and AI-integrated processing further reinforce the indispensability of optical modules in current products.

Innovative forms such as naked-eye 3D devices, holographic projection, and immersive displays are becoming more widespread, placing tighter demands on optical systems for clarity, field of view, efficiency, and miniaturization. Looking ahead, optical perception will be a core capability for future hardware, and rising performance thresholds will open new interaction modes and create possibilities beyond today’s applications. Precision optical solutions therefore are supporting 3D reconstruction, real-time analysis, and multi-modal interaction with high integration and stability, enabling broader adoption across smart homes, education, offices, and entertainment.

Leading Consumer Electronics Companies Guides Market Trends

Leading companies with extensive experience in consumer electronics precision optical solutions leverage mature optical design, precision packaging, automated manufacturing, and large-scale delivery capabilities to swiftly enter emerging markets, becoming key drivers of industry-wide smart upgrades. New-generation AI hardware demands thinner, lower-power, lower-latency, and multi-modal collaborative solutions. Leading companies, with accumulated expertise in optical design, VCM drives, image algorithms, and micro-packaging, hold first-mover advantages in providing high-performance key optical modules.

Additionally, top-tier consumer electronics precision optical solutions providers are collaborating with leading large-model AI companies to deeply embed AI algorithms into smart devices, enabling intelligent perception, semantic understanding, and environmental interaction, thereby accelerating the adoption of new AI hardware. Through module R&D, vertical integration, and system-level coordination, combined with AI-driven intelligent perception and interaction algorithms, precision optical solutions are advancing toward a new stage characterized by high precision, high integration, and high value, providing robust support for the emerging AI hardware market.

ENTRY BARRIERS ANALYSIS OF GLOBAL PRECISION OPTICAL SOLUTIONS INDUSTRY

The global precision optical solutions industry is characterized by significant entry barriers across multiple dimensions. Customer relationship barriers arise from deep integration into smart device manufacturers’ supply chains, requiring extensive qualification processes and long validation cycles. Technological barriers stem from the need for advanced capabilities in optical design, image processing, and high-precision module development. Intelligent manufacturing barriers reflect the reliance on highly automated production systems to ensure precision, yield, and consistency at scale. Capital barriers are driven by substantial investment requirements in high-precision equipment, automated production lines, and R&D infrastructure. Talent barriers result from the need for multidisciplinary expertise in optics, algorithms, hardware integration, and process engineering, which requires long-term accumulation.

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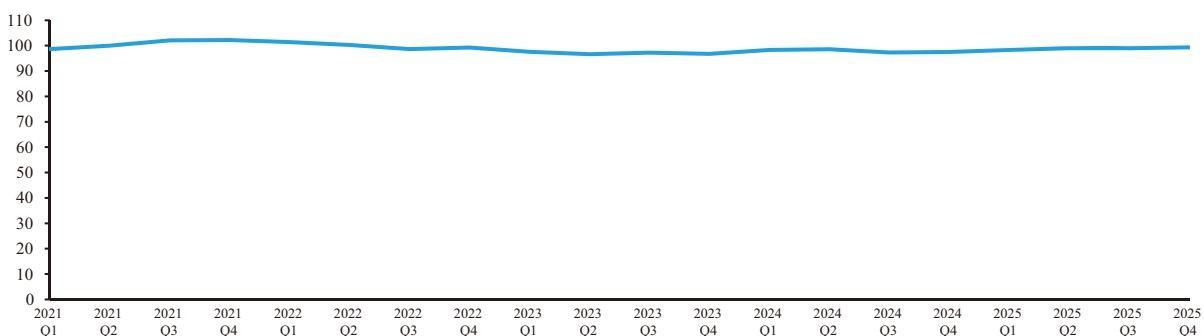
MARKET CHALLENGE ANALYSIS OF GLOBAL PRECISION OPTICAL SOLUTIONS INDUSTRY

The global precision optical solutions industry currently faces multiple challenges, compelling companies to seek breakthroughs in technology, cost efficiency, and market competitiveness. First, as downstream applications typically have a higher requirement on image quality, integration density, intelligent perception and other features, the pace of technological evolution has significantly accelerated. Companies need to continuously increase their R&D investment to maintain their technological leadership. However, high R&D intensity also brings pressure on resource allocation and cycle management. Second, fluctuations in raw material prices, increased process complexity, and changes in the global manufacturing and supply chain environment have made cost control more difficult, further squeezing profit margins. Moreover, intensifying market competition has intensified fierce competition between traditional precision optical solutions providers and new entrants in specialized segments such as 3D perception and AR/VR optics. Leading enterprises are widening their competitive advantage through capital and ecosystem synergies, creating survival pressures for small and medium-sized players. Overall, while technological evolution drives transformation, it also raises entry barriers and accelerates market segmentation, presenting the entire industry with structural challenges during its transformation and upgrading.

RAW MATERIAL PRICE ANALYSIS OF GLOBAL PRECISION OPTICAL SOLUTIONS INDUSTRY

The Producer Price Index (PPI) for the electronic component manufacturing industry is a key indicator reflecting cost fluctuations of industry-related raw materials. Electronic components serve core functions in optical modules, including signal processing, drive control, data transmission, and imaging computation, with their performance and supply directly determining the precision, response speed, and stability of optical modules. From 2021 to 2025, the PPI remained relatively stable, providing a consistent cost foundation for precision optical module manufacturing and enabling companies to maintain predictable cost structures in both technology development and capacity expansion.

Producer Price Index for the Electronic Component Manufacturing Industry, 2021–2025



Source: State Statistics Bureau, Frost & Sullivan

INDUSTRY OVERVIEW

SOURCE OF INFORMATION

We commissioned Frost & Sullivan to conduct market research on precision optical solutions industry and prepare the F&S Report. Frost & Sullivan is an independent global consulting firm founded in 1961 in New York that offers industry research and market strategies. We have contracted to pay RMB680,000 to Frost & Sullivan for compiling the F&S Report.

In preparing the F&S Report, Frost & Sullivan conducted detailed primary research which involved discussing the status of the industry with certain leading industry participants and conducting interviews with relevant parties. Frost & Sullivan also conducted secondary research which involved reviewing company reports, independent research reports and data based on its own research database. Frost & Sullivan obtained the figures for the estimated total market size from historical data analysis plotted against macroeconomic data as well as considered the above-mentioned industry key drivers. Its market engineering forecasting methodology integrates several forecasting techniques with the market engineering measurement-based system and relies on the expertise of the analyst team in integrating the critical market elements investigated during the research phase of the project. These elements primarily include expert-opinion forecasting methodology, integration of market drivers and restraints, integration with the market challenges, integration of the market engineering measurement trends and integration of econometric variables.

The F&S Report is compiled based on the following assumptions: (i) the social, economic and political environment of the globe is likely to remain stable in the forecast period; and (ii) related industry key drivers are likely to drive the market in the forecast period.