

Market Prospects and Development Trends of the PCB Industry in 2025

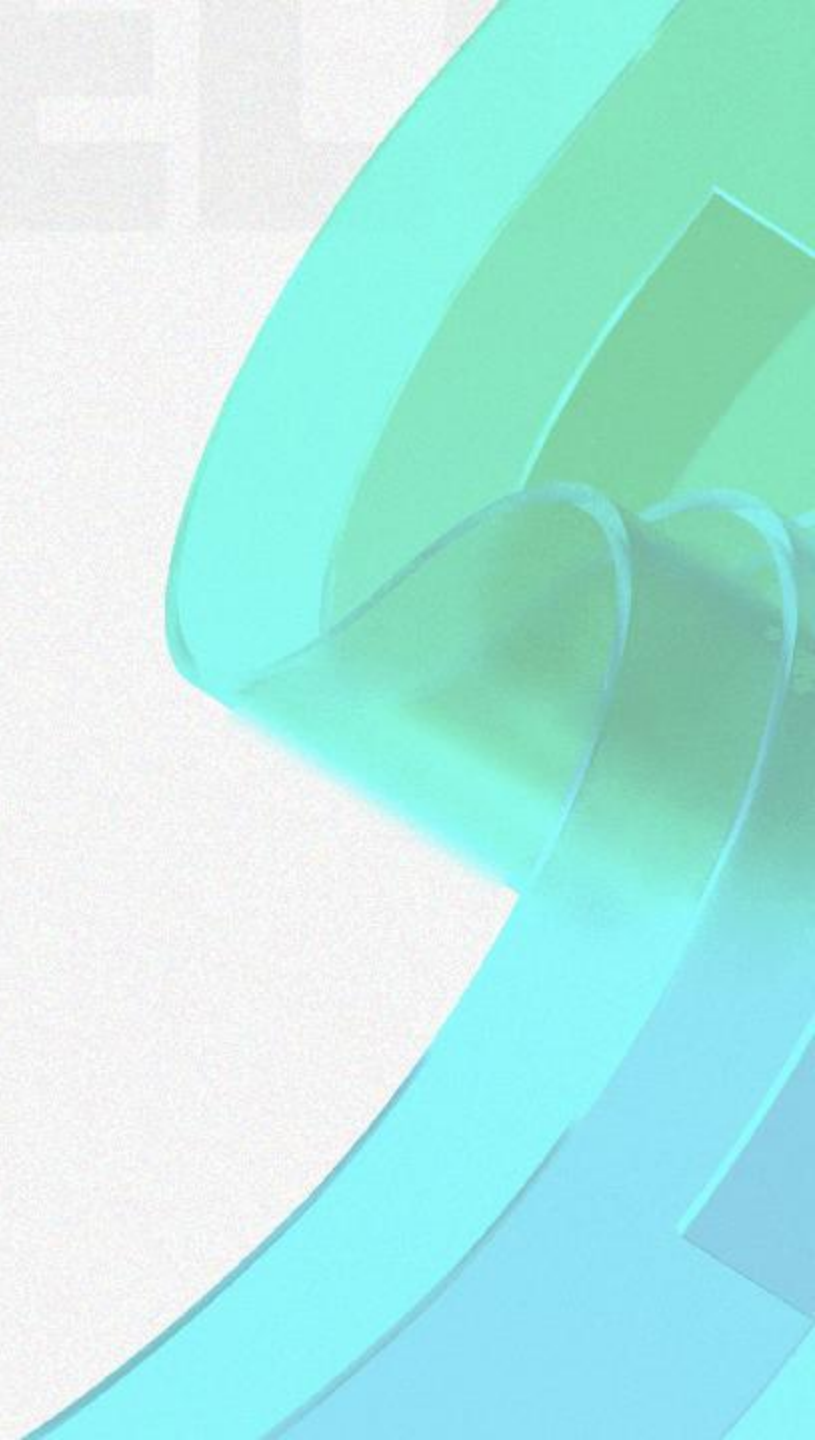


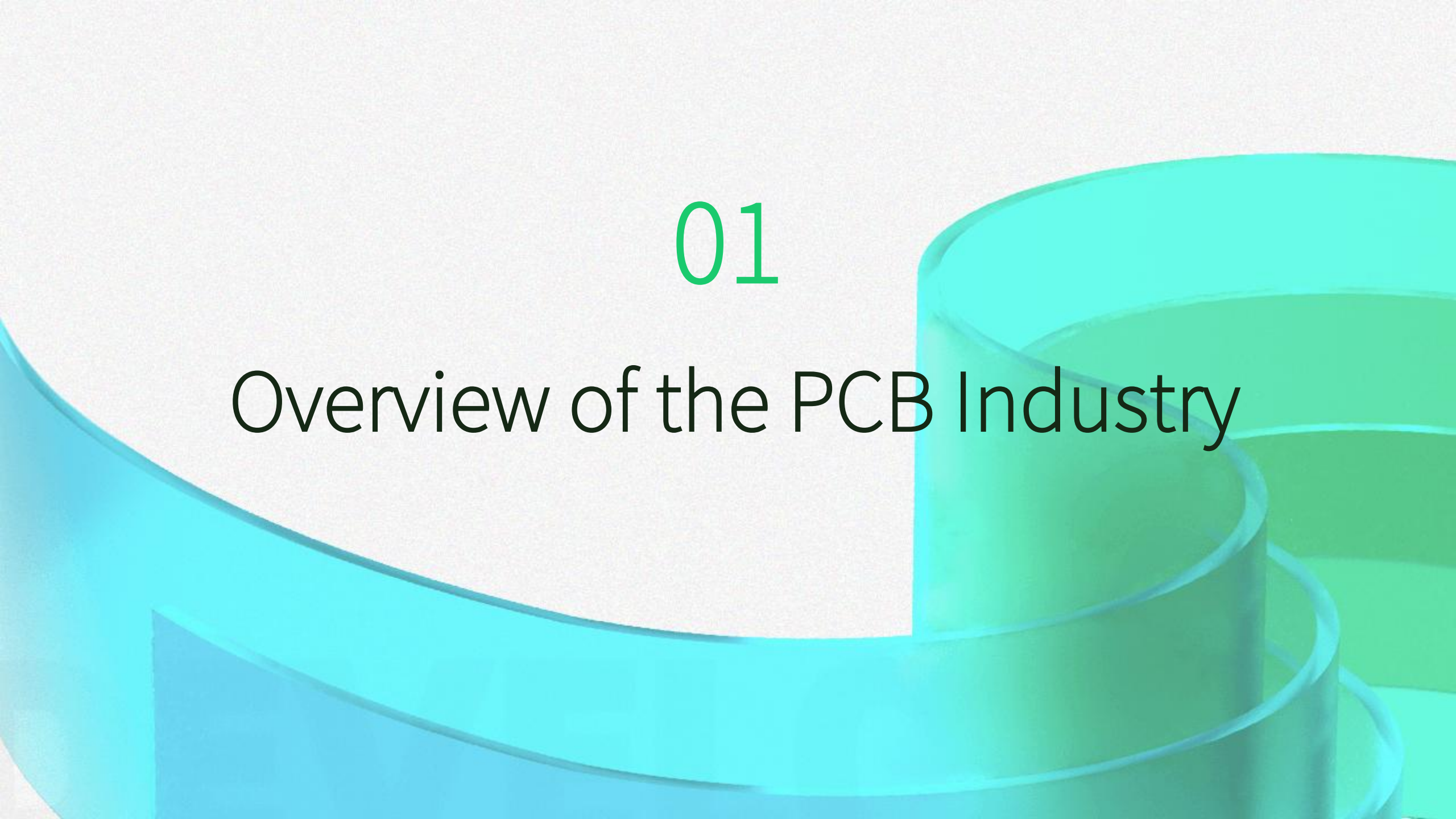
Presenter: FR4PCB.TECH

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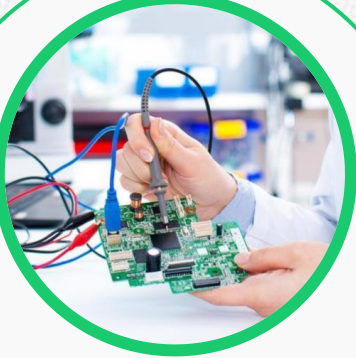




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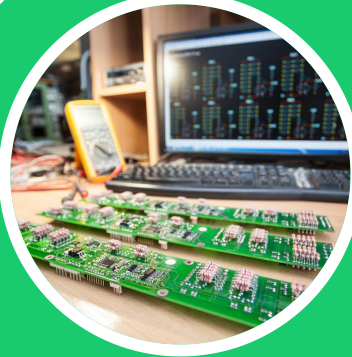
Overview of the PCB Industry

Definition and Core Functions of PCB (Printed Circuit Board)



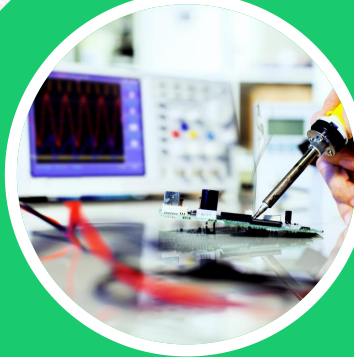
Electronic Interconnection Carrier

PCB (Printed Circuit Board) serves as the supporting structure and electrical interconnection carrier for electronic components, enabling signal transmission and power distribution among components through copper foil circuits. It is hailed as the "mother of electronic products."



Foundation of Integration

By employing high-density routing designs to replace traditional manual wiring, PCBs significantly enhance the integration level and reliability of electronic devices, serving as core components in products such as smartphones, servers, and automotive electronics.



Determinants of Performance

Parameters such as the number of layers, dielectric constant, and thermal dissipation performance of PCBs directly impact the signal integrity, power consumption, and heat dissipation efficiency of end-use devices, particularly crucial in high-speed computing scenarios (e.g., AI servers).



Driven by Technological Iteration

From early single-layer boards to modern advanced HDI (High-Density Interconnect) boards, the technological evolution of PCBs has continuously propelled electronic products towards thinner, lighter, and more multifunctional designs.

PCB Classification (Single/Double-Sided Boards, Multilayer Boards, HDI, etc.)



- **Market Size Accelerates Recovery:** The market size in 2024 witnessed a year-on-year growth of 13.4% (412.11 billion yuan vs. 363.257 billion yuan), with the growth rate expected to slow down to 5.1% in 2025, reflecting the gradual realization of AI-driven demand.
- **High-End Products Dominate Growth:** In 2023, multilayer boards accounted for 45.2% (exceeding 160 billion yuan) of the market, while HDI boards accounted for 14.8%. Boards with 18+ layers experienced a growth rate of 25.2%, underscoring the trend towards higher layer counts and higher density technologies.
- **Significant Room for Localization:** China accounts for 56% of the global PCB production value (73.6 billion USD in 2024), yet its share of mid-to-high-end products is less than 30% (compared to Japanese and South Korean companies), presenting opportunities for structural upgrades.

Industrial Chain and Global Landscape

01 Upstream Materials

Copper-clad laminates (CCL), copper foils, resins, and other materials account for over 60% of the costs. High-end materials such as ABF films (used in packaging substrates) still rely on Japanese companies (like Ajinomoto Co., Inc.), with domestic substitution efforts focusing on high-frequency and high-speed copper-clad laminates.

02 Midstream Manufacturing

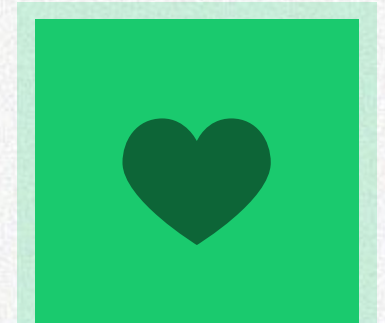
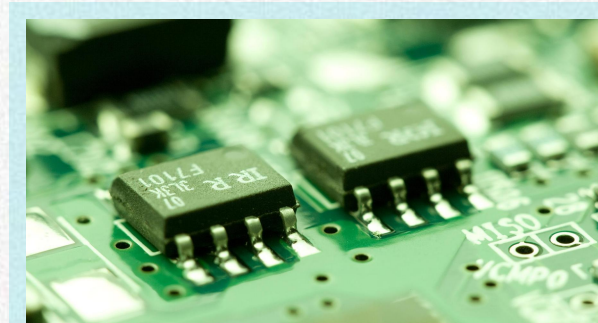
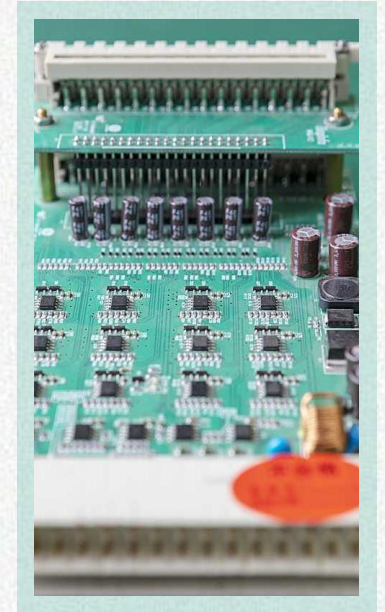
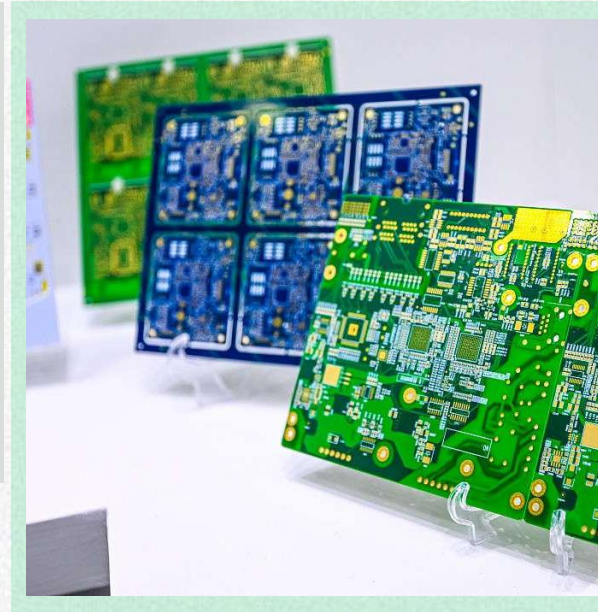
China accounts for 56% of global production capacity, yet high-end HDI/package substrates are primarily dominated by Taiwan-funded enterprises (such as Zhen Ding Technology and Unimicron) and Japanese/South Korean companies (like Samsung Electro-Mechanics and Ibiden). Domestic enterprises are accelerating breakthroughs in technology for 28-layer+ server boards.

03 Downstream Applications

Consumer electronics (accounting for 30%), communication equipment (25%), and automotive electronics (15%) are the three major demand drivers. AI servers and new energy vehicles are driving the proportion of high-end PCBs to rise from 20% to 35% by 2025.

04 Regional Clusters

The Yangtze River Delta and Pearl River Delta regions have formed a complete PCB industrial belt, with policy guidance promoting upgrades to high-end products. For instance, Shennan Circuits focuses on substrate manufacturing, while Wus Printed Circuit specializes in automotive radar boards, fostering differentiated competition with Europe, the United States, and Japan.





02

Market Size and Growth Drivers

Global market size in 2024: US\$73.6 billion

Core carrier of electronic products

As the supporting structure and electrical connection carrier for electronic components, PCBs span across various fields including telecommunications, consumer electronics, and automotive electronics. In 2024, the global output value of PCBs reached US\$73.6 billion, representing a year-on-year increase of 5.8%, underscoring their irreplaceable role in the industrial chain.



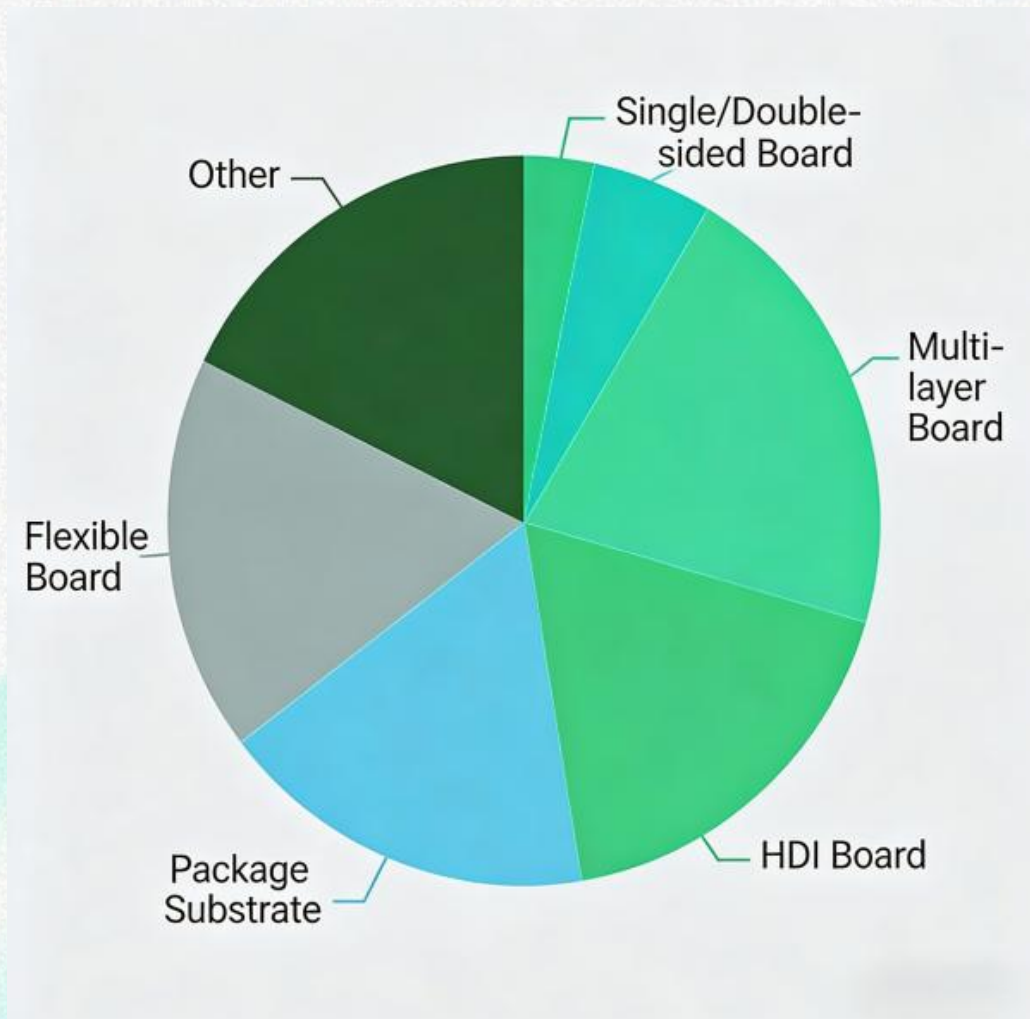
Trends towards Multi-layer and High-density Designs

With the soaring demand for AI servers and high-speed networking equipment, the output value of high-multi-layer boards with over 18 layers surged by 25.2% year-on-year, while HDI boards increased by 18.8%. This is propelling the industry to upgrade towards areas with high technological barriers.

Expectation of long-term stable growth

Prismark forecasts a Compound Annual Growth Rate (CAGR) of 5.2% for the period from 2024 to 2029, with the global output value expected to reach US\$94.661 billion by 2029, reflecting the sustained penetration potential of PCBs in the era of intelligence.

China's market share and production base status (56%)



- **HDI Boards Leading Growth:** HDI boards account for 18.8% of the output value, with a year-on-year increase of 18.8%, significantly outperforming other types. This growth is primarily driven by demand from AI servers and optical modules.
- **Strong Demand for Multilayer Boards:** The output value of multilayer boards with over 18 layers increased by 25.2% year-on-year, with production volume rising by 35.4%. This reflects the urgent demand for high-layer-count PCBs from AI servers.
- **China Dominates Production:** China accounts for 56% of global PCB output value, reaching US 41.213 billion in 2024, and is expected to grow to US 43.734 billion in 2025, highlighting its status as a global production hub.
- **High-End Technology Drives Both Volume and Value Growth:** PCBs for AI servers reach 20-28 layers, with the value per unit increasing to US\$8,000-10,000, driving both volume and value growth in the industry.

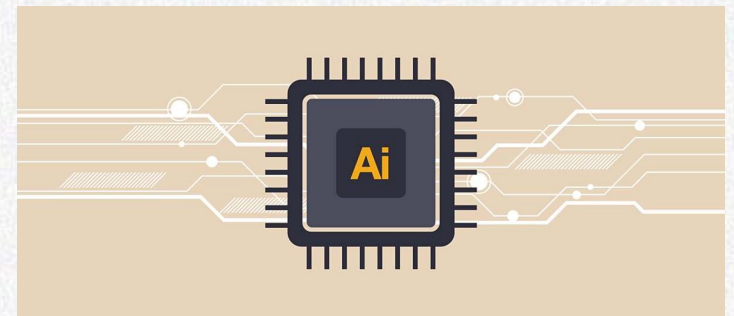
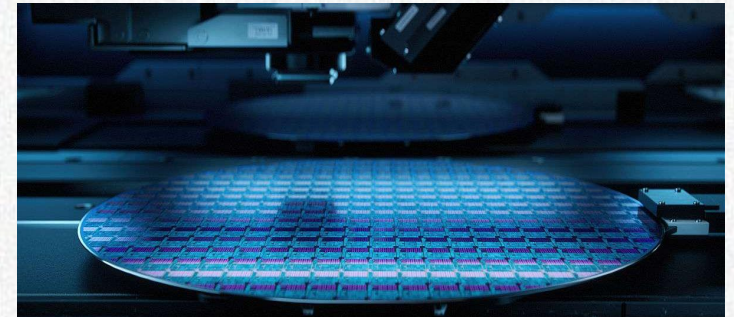
Growth driven by AI/computing power demand

AI servers catalyze a simultaneous increase in both volume and value of high-end PCBs.

- The per-unit value soars: The PCB layer count in AI servers reaches 20-28 layers, with the per-unit value escalating to US\$8,000-10,000, marking a 3-5 times increase compared to traditional servers.
- Urgent demand for material upgrades: High-frequency and high-speed CCL (copper-clad laminate) accounts for 27.3% of material costs, with low-loss resins and ultra-thin copper foils becoming key focuses for technological breakthroughs.

Collaborative boom in the computing hardware industry chain

- Financial reports from giants like NVIDIA validate the thriving computing power market, with revenue reaching US\$57 billion in Q3 of fiscal year 2026 (a 62% year-on-year increase), directly driving demand for high-speed, high-layer PCBs and supporting PCBs for optical modules.
- Domestic leaders such as WUS Printed Circuit and Shennan Circuits are accelerating capacity expansion, with the proportion of production capacity for boards with over 18 layers rising to 30%, aligning with the construction cycle of AI data centers.





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Technology development trends

High layer count/high density (multilayer boards with 18+ layers growing by 25.2%)



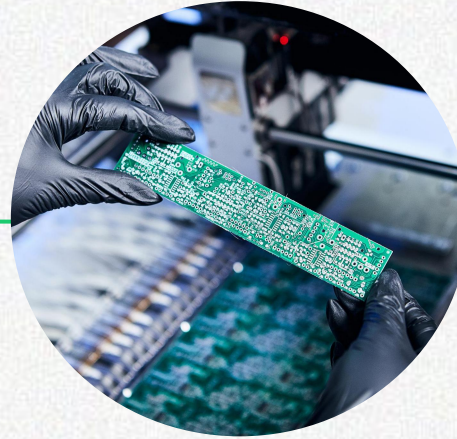
Layer count breakthrough

The demand from AI servers has driven the PCB layer count to soar to 28-46 layers, with the output value of high-layer-count multilayer boards (18+ layers) growing by 25.2% year-on-year, meeting the requirements for signal integrity and heat dissipation in high-performance computing.



Material upgrade

The utilization ratio of high-frequency and high-speed materials (such as Rogers' high-frequency copper-clad laminates) has increased, with copper foil thickness trending towards an ultra-thin 6 μ m to reduce transmission losses and enhance routing density.



Process innovation

By adopting mSAP (Modified Semi-Additive Process) and laser drilling technology, precision machining with a line width/spacing of $\leq 50\mu\text{m}$ is achieved, supporting the demands for high-density interconnect (HDI).



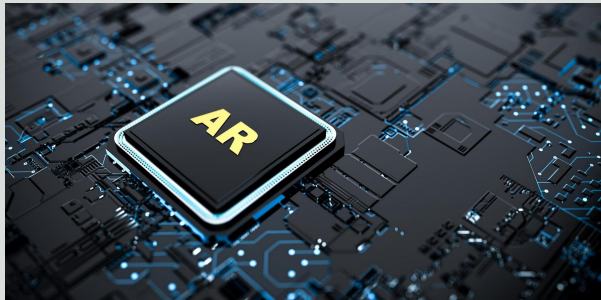
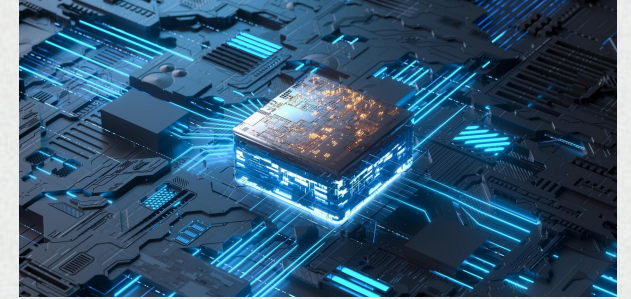
Domestic substitution

Shengyi Technology's S8/S9 high-speed materials have passed NVIDIA's certification, breaking the technological monopoly held by U.S. and Japanese companies in the high-end copper-clad laminate sector.

Explosive growth in HDI boards (with an 18.8% increase in 2024)

Driven by AI servers

Due to the soaring demand for high-precision routing driven by AI servers, the output value of HDI boards surged by 18.8% in 2024, with a notable increase in the proportion of Any-layer HDI boards.



Consumer electronics iteration

Foldable phones and AR/VR devices utilize multi-layer HDI boards to achieve component miniaturization and motherboard space compression, driving up the value of PCBs per unit by over 30%.

Technological convergence

The integration of HDI and IC substrate technologies, through embedded passive components (such as capacitors/resistors), further reduces the volume of board assemblies, catering to the demands of 5G-A/6G communication equipment.



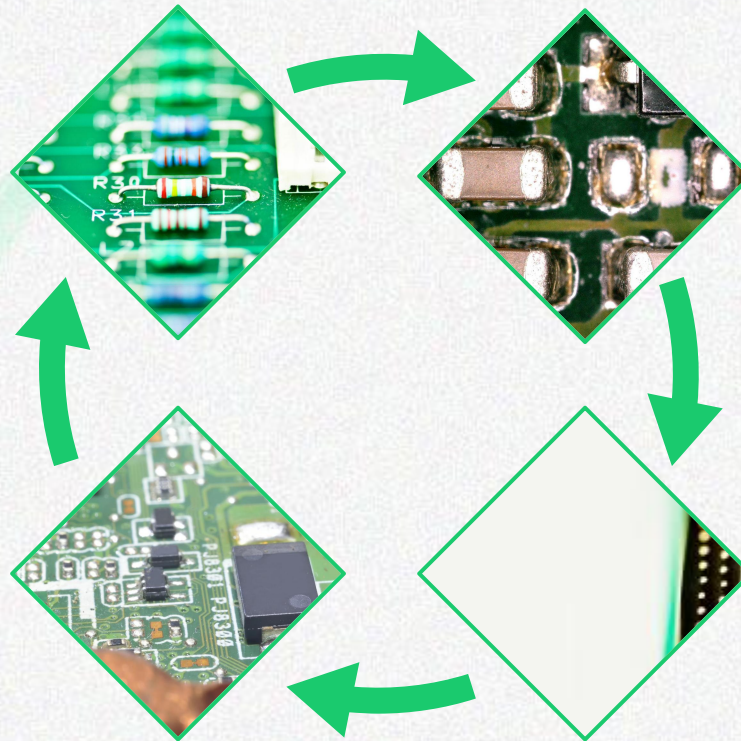
Package substrate and advanced material applications

Advanced packaging support/solutions

The demand for FC-BGA (Flip Chip Ball Grid Array) substrates has surged, supporting the packaging of CPU/GPU chips with a line width precision requirement of under $10\mu\text{m}$.

Localization breakthrough

Domestic enterprises are accelerating their efforts to master ABF (Ajinomoto Build-up Film) substrate technology, filling the capacity gap for 2.1D/2.5D packaging substrates.

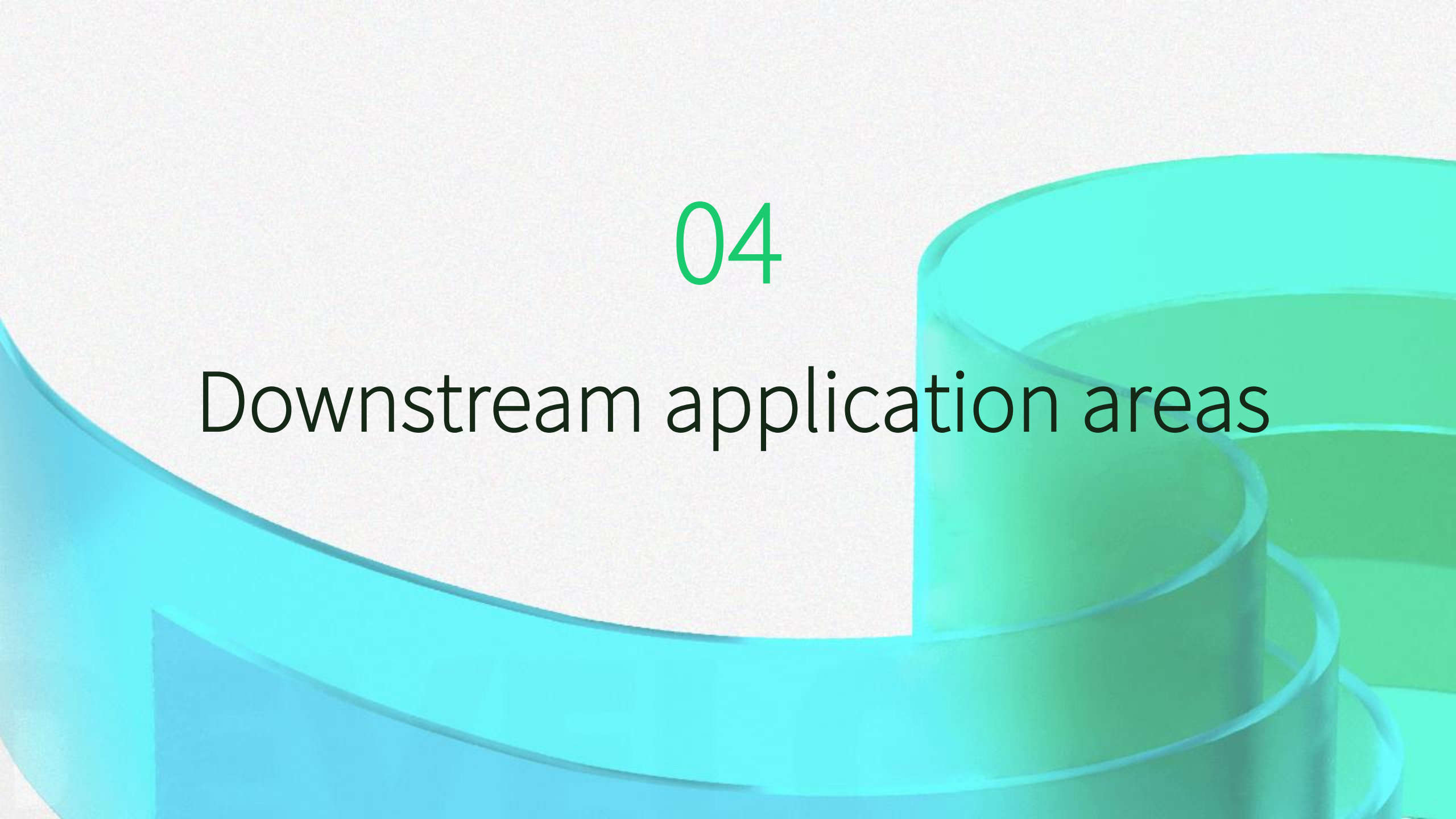


Penetration of high-frequency materials

The application of polytetrafluoroethylene (PTFE) and hydrocarbon resin copper-clad laminates has expanded in millimeter-wave radar and satellite communication fields, with the dielectric constant (D_k) reduced to below 3.0.

Thermal management solutions

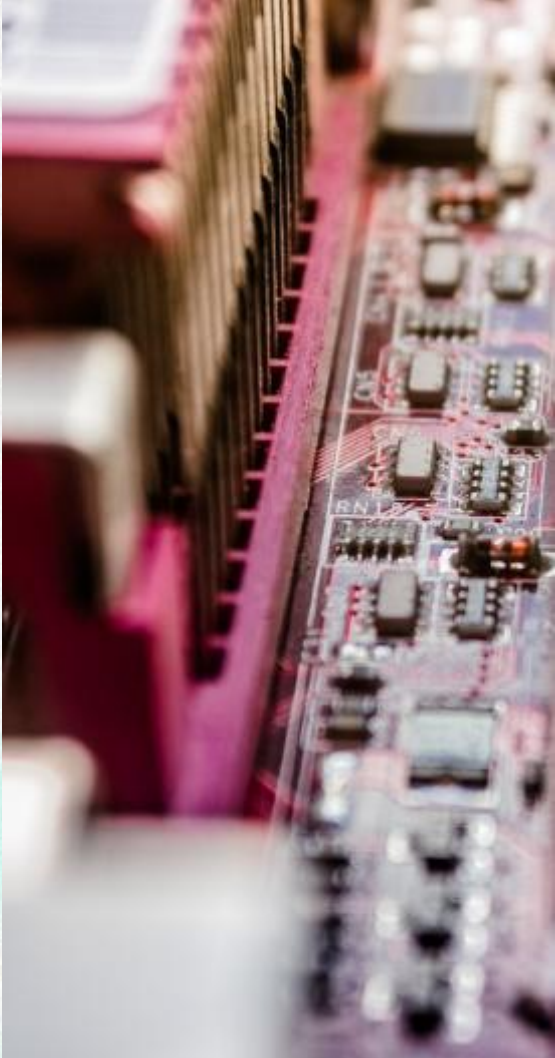
The proportion of aluminum nitride (AlN) ceramic substrates and metal substrates (such as copper-invar-copper) in the electric control modules of new energy vehicles has increased by 30%, addressing the challenge of high-power heat dissipation.

The background features abstract, flowing shapes in shades of teal and blue. On the left, a wide, curved band sweeps across the frame. On the right, a series of concentric, rounded rectangular shapes are stacked vertically, creating a sense of depth and movement.

04

Downstream application areas

AI servers/optical modules (with high-end HDI requirements)



Driven by the upgrade of computing power architecture

As AI servers evolve from GPU-based architectures towards orthogonal and cable-free designs, the shortened signal transmission paths have heightened sensitivity to material losses. Consequently, high-end HDI boards have emerged as the core interconnect components, required to meet the demands of high-density routing, low signal loss, and superior heat dissipation.

Technological iteration of optical modules

The upgrade to 800G/1.6T optical modules has driven the increase in PCB layers to over 18, necessitating materials with lower dielectric constant (D_k/D_f) and higher dimensional stability, and significantly raising the proportion of high-frequency and high-speed materials used.

Complexity of power supply systems

The GPU accelerator cards and UBB (Universal Backplane Board) substrates in AI servers require HDI boards with over 12 layers combined with copper pillar embedding technology to achieve high current carrying capacity and efficient heat dissipation, driving up the unit price of high-end HDI boards by 30%-50%.

Automotive electronics (millimeter-wave radar, intelligent driving)

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Millimeter-wave radar PCB technology

77GHz radar requires the use of PTFE high-frequency materials, demanding that the dielectric constant tolerance of the PCB be controlled within ± 0.02 , and necessitating stable control of microstrip line impedance accuracy at $\pm 5\%$. This drives the demand for high-end RF PCBs.

02

Multi-layer Architecture of Domain Controllers

The intelligent driving domain controller adopts an 8 - 16 layer any-layer HDI design, integrating signals from multiple sensors such as cameras and LiDAR. It requires the board thickness to be controlled within 0.8mm while maintaining a line width/spacing accuracy of $10\mu\text{m}$.

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New Energy High - Voltage System

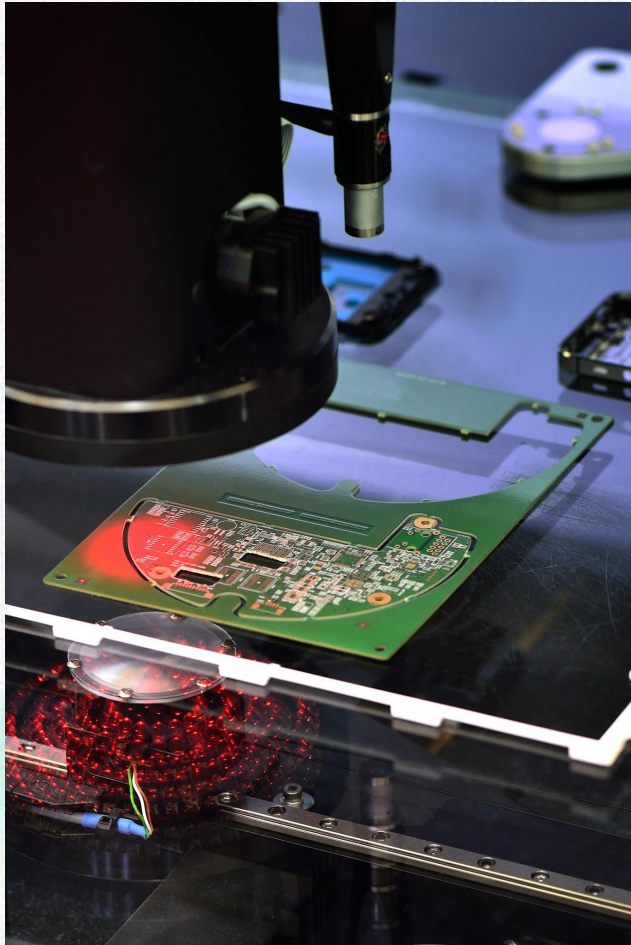
The demand for thick-copper PCBs (above 3oz) driven by the 800V platform, where power modules utilize AMB ceramic substrates and require the coefficient of thermal expansion (CTE) to match chip-level packaging requirements.

04

Obstacles in Obtaining Automotive - Grade Certifications

Automotive PCBs need to pass the AEC-Q100 certification and maintain reliability for over 10 years under harsh conditions such as temperature cycling ($-40^{\circ}\text{C} \sim 150^{\circ}\text{C}$) and mechanical vibration. Leading manufacturers strengthen their competitive edge by adopting the IATF16949 system.

Consumer Electronics (Mini - LED, IoT)



Mini - LED Backlight Technology

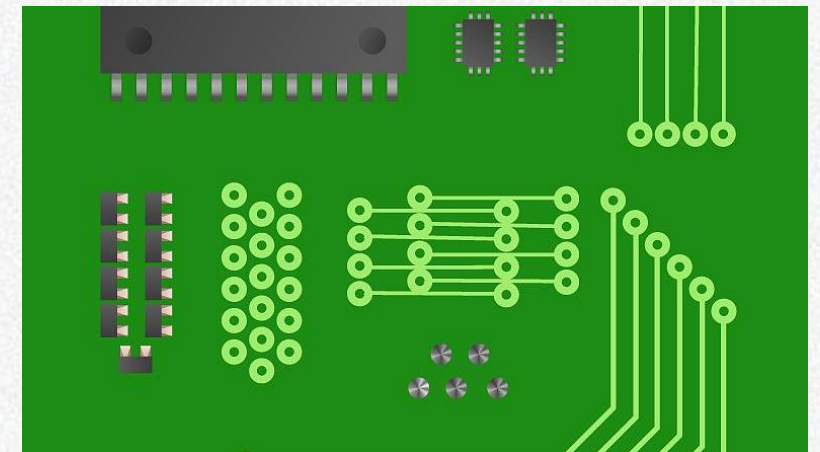
4K/8K TVs employ HDI boards with over 12 layers, requiring the processing of micro - pitch pads with a pitch below 0.3mm. Additionally, the copper paste hole - filling process is adopted to address the warping issue caused by local high temperatures.

Flexibilization of Wearable Devices

IoT devices employ rigid - flex printed circuit boards, with a bending radius requirement of less than 3mm and the need to withstand over 50,000 dynamic bends. LCP material antenna modules have become a standard feature for 5G wearable devices.

Semiconductor Test Interface

The probe card employs an ultra - high - precision PCB (with a line width of $\leq 20\mu\text{m}$). It requires a Z - axis coefficient of thermal expansion (CTE) of $\leq 8\text{ppm}/^\circ\text{C}$ to match the thermal cycling conditions during wafer testing, and the penetration rate of the mSAP process continues to rise.





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Competitive Landscape and Investment Trends

Domestic leading enterprises are expanding production (such as Qiangda Circuit's high - end HDI project)

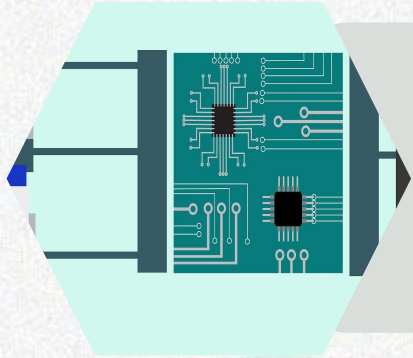
Technological breakthroughs drive production expansion

Qiangda Circuit focuses on the fields of High - Density Interconnector (HDI) boards and high - multi - layer boards with over 18 layers. Through independent research and development, it has made arrangements in the application of high - frequency materials and precision manufacturing process technologies. Its high - end HDI project has filled the technological gaps in signal integrity and heat dissipation performance of domestic high - end PCBs, accelerating the replacement of market shares previously held by Japanese and South Korean enterprises.

Ramp - up of production capacity to match demand

As the demand for high - layer - count PCBs surges in fields such as AI servers and automotive electronics, the company has achieved rapid production capacity release through the upgrading of intelligent production lines. After the project reaches its full capacity, it is expected to fill more than 30% of the supply gap for high - end PCBs in China's AI computing infrastructure.

Storage Localization and Equipment Demand

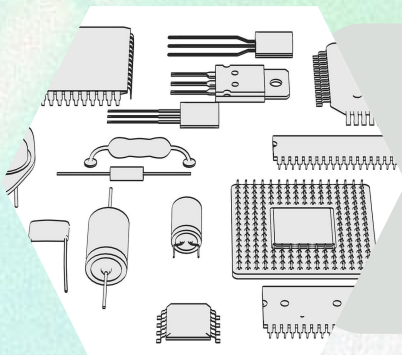
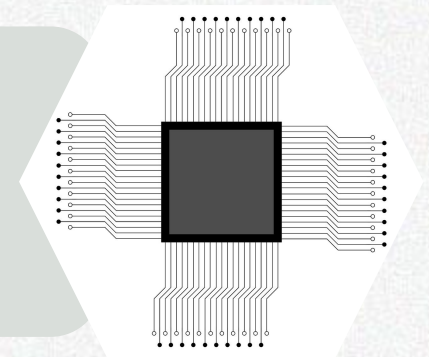


Upgrading of supporting components for memory chips

The technological iterations of 3D NAND/DRAM by domestic manufacturers such as Yangtze Memory Technologies (YMTC) and ChangXin Memory Technologies (CXMT) have triggered an explosive demand for packaging substrates (e.g., FC - CSP and SiP carriers). This, in turn, has driven PCB equipment manufacturers to witness over a 50% increase in orders for processes like laser drilling and vacuum lamination.

The process of material localization is accelerating

The localization rate of key materials such as high - frequency and high - speed copper - clad laminates and special resins has increased from less than 20% to 35%. Enterprises like Qiangda Circuit have collaborated with upstream suppliers to develop low - loss materials, breaking the overseas monopoly on core materials for high - frequency PCBs.



There is a surge in demand for testing equipment

Memory chips impose stringent requirements on the PCB defect rate (≤ 50 ppm), driving the annual compound growth rate of the market size for AOI inspection and X-ray inspection equipment to exceed 25%. Companies such as Han's CNC have launched high - precision multi - spectral inspection solutions to seize market share.

Capital Expenditure Cycle (Supply - Demand Gap in 2026 - 2027)

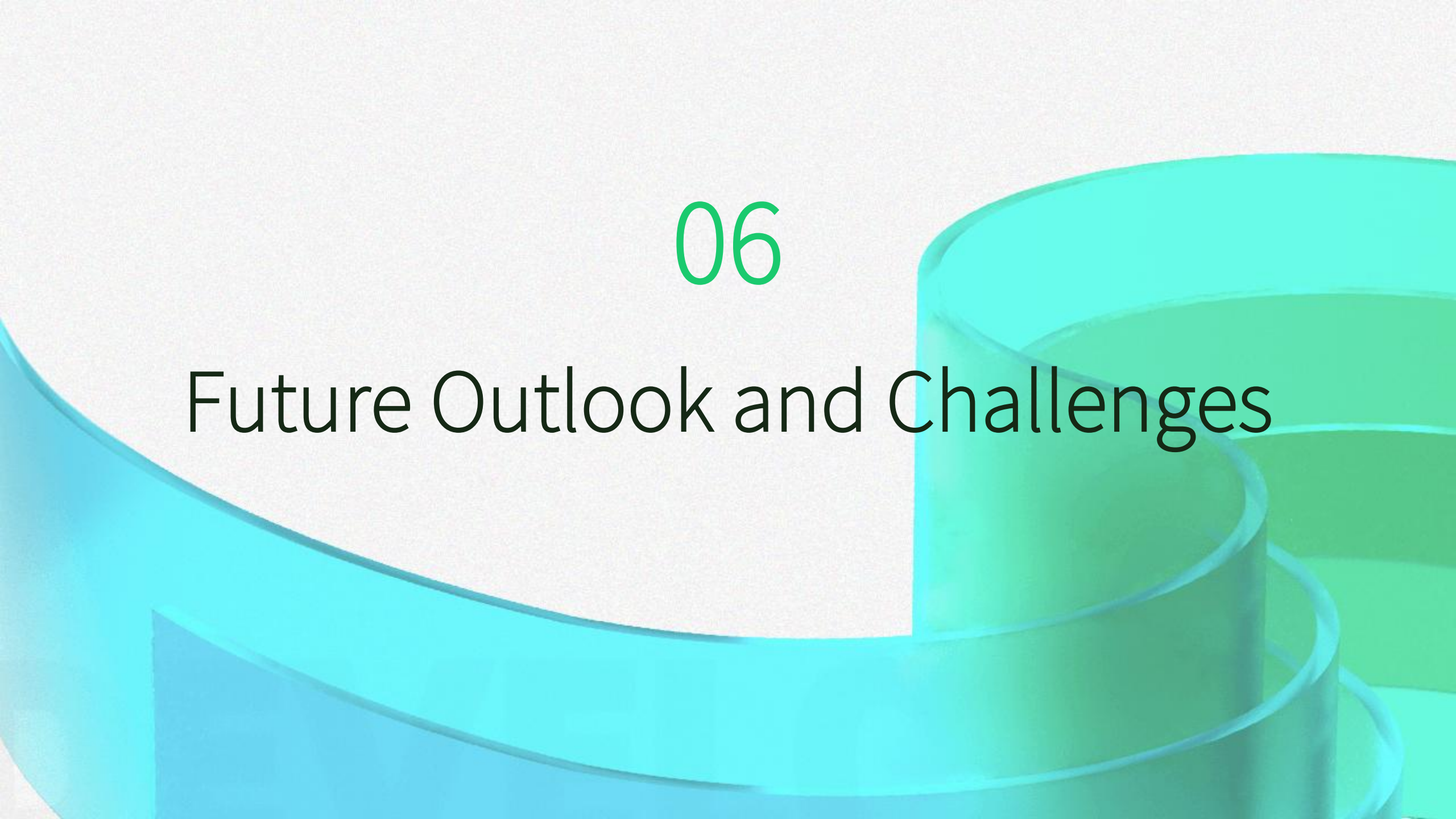


Global production capacity is experiencing structural tension

The explosive demand for AI servers and automotive electronics has driven the capacity utilization rate of high - multi - layer boards with over 18 layers to reach 95%. By 2026, the global capacity gap for high - end PCBs is projected to reach 1.2 million square meters. Manufacturers such as Avary Holding have made early arrangements by setting up bases in Thailand and Huai'an to cope with delivery pressures.

Equipment manufacturers benefit from the wave of capacity expansion

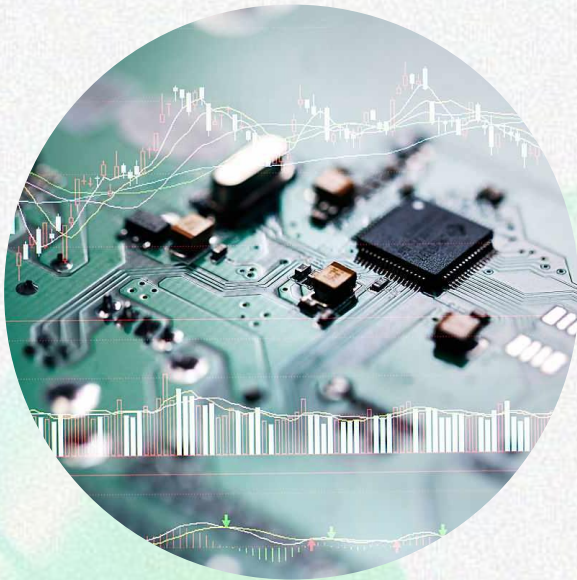
PCB manufacturers have seen their capital expenditures increase by over 30% year-on-year. The procurement volume of core equipment such as drilling machines and LDI exposure machines has doubled. Leading equipment players like Han's CNC have adjusted their fund - raising and investment projects to prioritize meeting the demands of high - end production lines.



06

Future Outlook and Challenges

Forecast for 2029: US\$94.6 billion, with a Compound Annual Growth Rate (CAGR) of 5.2%



High - end products are driving the growth

High - end PCB categories such as IC substrates and HDI boards are set to contribute over 60% of the incremental output value. Among them, IC substrates will achieve an annual growth rate of 9%, driving the overall market to transform towards high - value - added products.

Explosive demand for multi - layer boards emerges

Driven by the construction of AI servers and data centers, high - end multi - layer boards with over 18 layers are expected to achieve a compound annual growth rate (CAGR) of 25.2% from 2025 to 2029. The PCB value per AI server is projected to exceed 5,000 yuan.

Regional production capacity differentiation

China's production capacity share is expected to rise to 58%. However, due to the demand for supply chain diversification in Southeast Asia, the annual growth rate of PCB production capacity in this region will reach 12%, forming a new industrial cluster belt.

Technical bottlenecks (heat dissipation and thinning)

Breakthrough in high - frequency materials

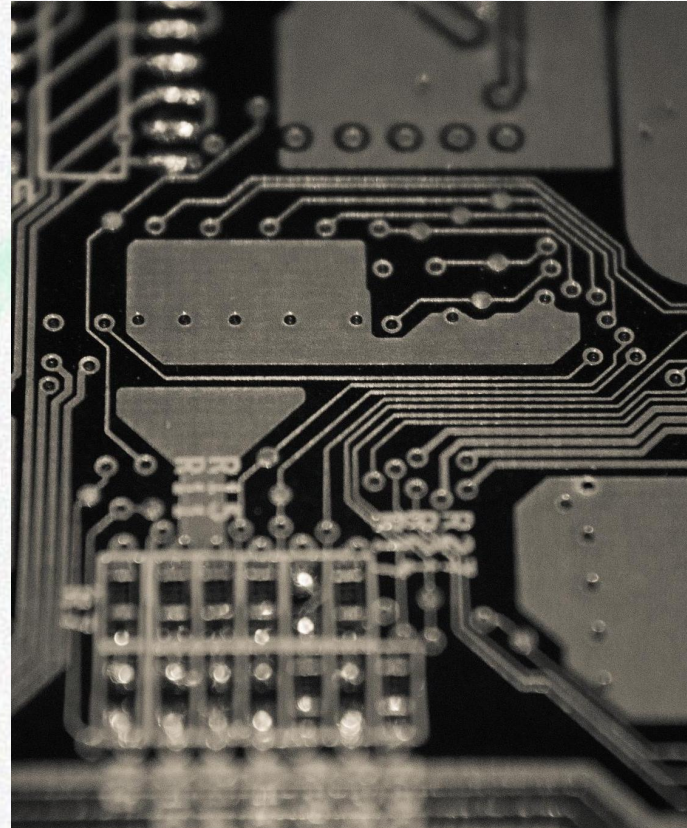
For 5G/6G communication, the dielectric loss of PCBs is required to be lower than 0.002.

Currently, the yield rate of modified PTFE materials stands at only 65%, and there is an urgent need to optimize them using nano - ceramic filling technology.

Limitations of Thinning Process

The etching precision requirement for ultra - thin copper foils below $30\mu\text{m}$ is $\pm 3\mu\text{m}$.

However, the cost of existing laser drilling equipment accounts for over 40% of the production line cost, which restricts its popularization speed.



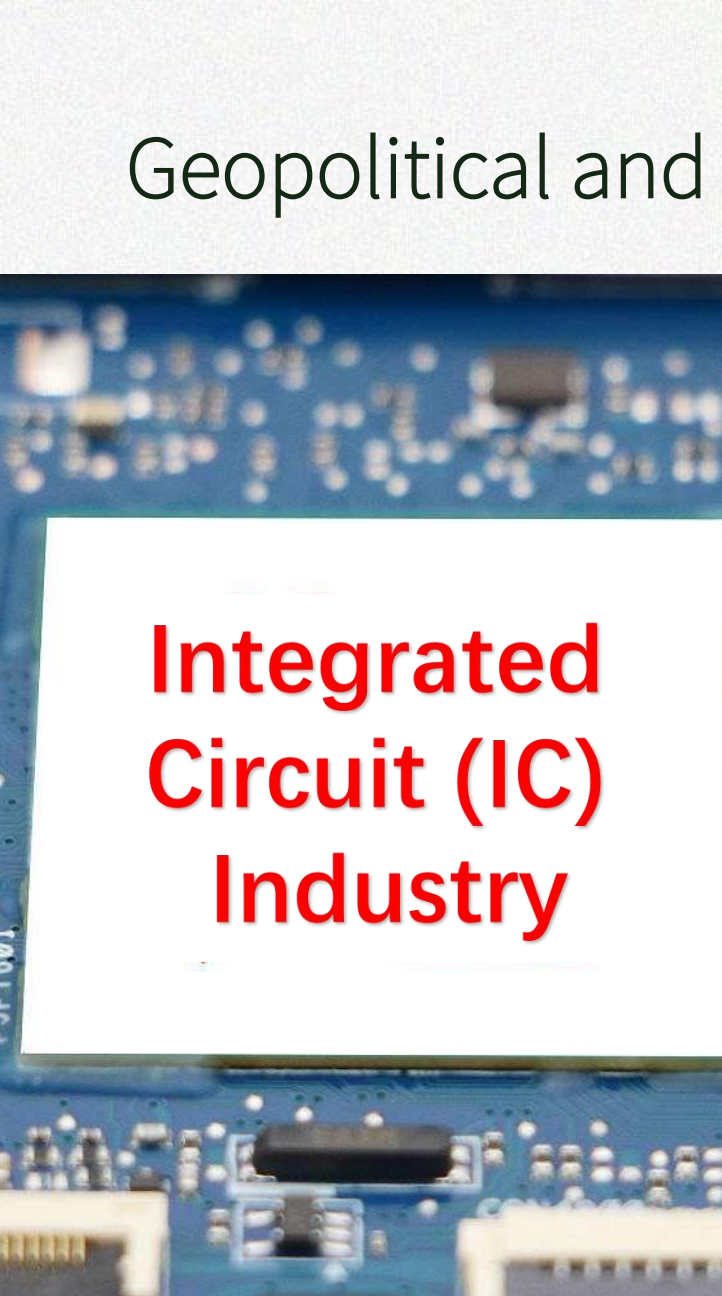
Thermal Design Challenges

The power consumption of AI chips has surpassed 1000W, while the thermal conductivity of traditional FR-4 substrates is less than 1W/mK. It is necessary to embed graphene or micro - channel liquid - cooling structures.

Signal Integrity Challenges

Under high - speed transmission at 112Gbps, the inter - layer crosstalk in multi - layer boards needs to be controlled below - 50dB, and the dielectric constant fluctuation rate is required to be less than 2%.

Geopolitical and Supply Chain Risks



Integrated Circuit (IC) Industry



Dependency on Critical Materials

Over 90% of high - frequency copper - clad laminate (CCL) resins in mainland China rely on supplies from Japanese companies. U.S. export controls may affect the production continuity of high - end printed circuit boards (PCBs).



Technical Barriers of Equipment

Core equipment such as photolithography machines and laser drilling machines are monopolized by Japanese and German manufacturers. The yield gap between domestic equipment and imported ones reaches 15 percentage points for printed circuit boards with more than 18 layers.



Regional Trade Barriers

The US and Europe plan to raise PCB tariffs to 8 - 12%. Exports from Southeast Asia need to meet the rules of origin (with a 35% value - added requirement), which will increase compliance costs by over 20%.



THANKS

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