

INDUSTRY OVERVIEW

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SOURCE OF INDUSTRY INFORMATION

In connection with the [REDACTED], we have engaged Frost & Sullivan, an independent market research consultant, to conduct a detailed analysis on Global and China’s PCB market prepare a report for use in this document, for which we have agreed to pay an engagement fee of RMB650,000, which we believe to be consistent with market rates.

In compiling and preparing the Frost & Sullivan Report, Frost & Sullivan adopted the following assumptions: (i) global social, economic and political environment is likely to remain stable in the period of 2024 to 2029 (the “**forecast period**”); (ii) purchasing power is expected to continue to rise moderately in emerging regions and to grow steadily in developed regions; and (iii) related industry key drivers are likely to drive the market in the forecast period.

Except as otherwise noted, all of the data and forecasts contained in this section are derived from the Frost & Sullivan Report. Frost & Sullivan has prepared the Frost & Sullivan Report based on detailed primary research which involved discussing the status of the Global and China’s PCB market with certain leading industry participants and secondary research which involved reviewing company reports, independent research reports and data based on its own research database. Our Directors confirm that, after taking reasonable care, there has been no material adverse change in the overall market information since the date of the Frost & Sullivan Report that would materially qualify, contradict or have an impact on such information.

OVERVIEW OF GLOBAL AND CHINA’S PCB MARKET

Definition

Printed Circuit Board (PCB) refers to a circuit board that forms conductive paths on an insulating substrate in accordance with a predetermined design. It enables various electronic components to establish connections in a predetermined circuit configuration and serves as a medium for intermediate signal transmission.

INDUSTRY OVERVIEW

Classification

PCB products can be classified into the following categories based on the structure.

- **Single-Layer PCB** refers to PCB where only one side of the substrate is a conductive layer.
- **Double-Layer PCB** refers to PCB where both sides of the substrate are conductive layers, allowing for higher component density and more complex circuit designs.
- **Multilayer PCB** incorporates 3 or more layers of conductive circuits, utilizing lamination and via interconnection technology.
- **High-Density Interconnect (HDI) PCB** refers to PCB with high line spacing density. It implements technologies such as micro-blind vias, micro-buried vias, additive manufacturing, and laser drilling.
- **Package Substrate** refers to PCB used for packaging, supporting, and connecting bare chips. It falls within the category of semiconductor packaging materials.
- **Flexible Printed Circuit (FPC)** refers to bendable PCB with traditional rigid copper-clad laminates replaced with flexible substrates such as PI or PET.

Value Chain Analysis

- ***Upstream: Providers of Materials, Manufacturing Equipment, and Supporting Services***

As the fundamental support, raw materials define the upper limit of product performance, applicable scenarios, and cost structure. As the core carrier of PCB manufacturing, specialized equipment guarantees production efficiency and precision. Supporting services facilitate the efficient operation, ensure the synergy, and determine the overall efficiency of the industrial chain.

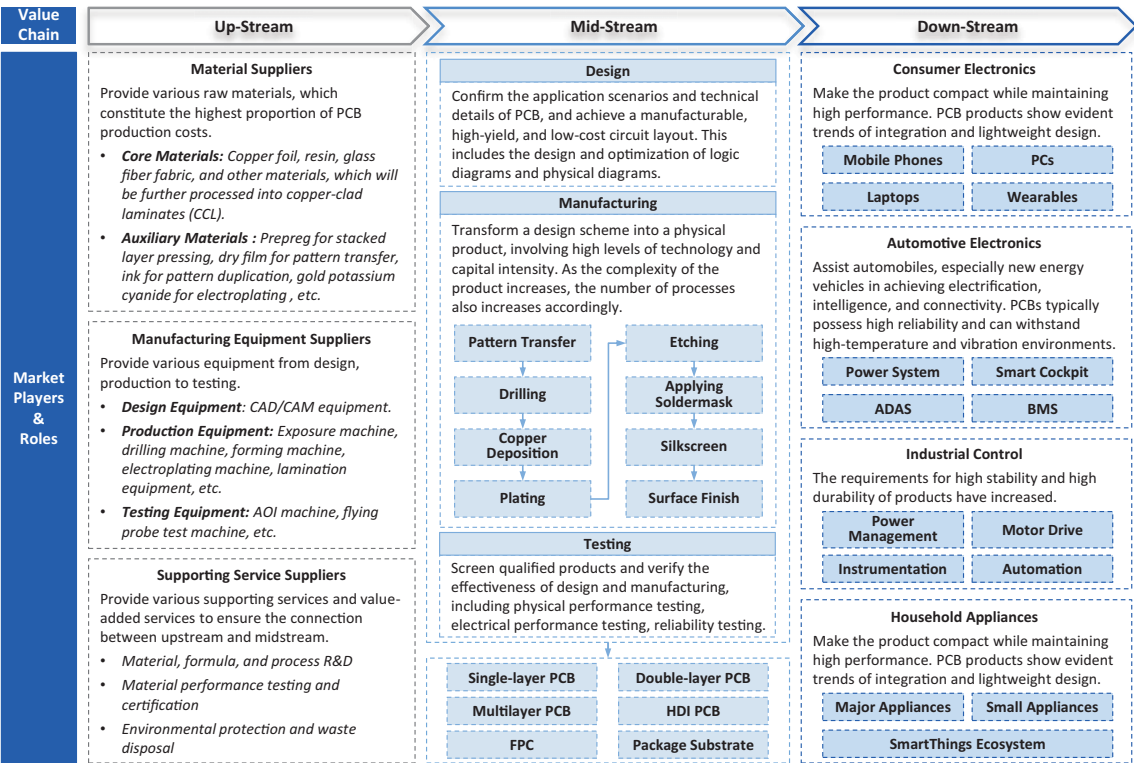
- ***Midstream: PCBs Manufacturing and Various Products Output***

The design phase dictates the functional feasibility and manufacturing economy of products. The manufacturing phase turns designs into physical products and is recognized as a technology-and-capital-intensive segment. The testing phase ensures the effectiveness of end products; moreover, test data can be leveraged to optimize design parameters and refine manufacturing processes, thereby feeding back into the design and manufacturing phases.

- ***Downstream: Various Sectors Related to Electronics Industry***

The downstream segment of the PCB industry covers all industries requiring the application of electronic devices, mainly including core fields such as consumer electronics, automotive electronics, industrial control, and household appliances. Distinct discrepancies exist in technical requirements and product types of PCBs across these sectors, resulting in market structural differentiation.

INDUSTRY OVERVIEW



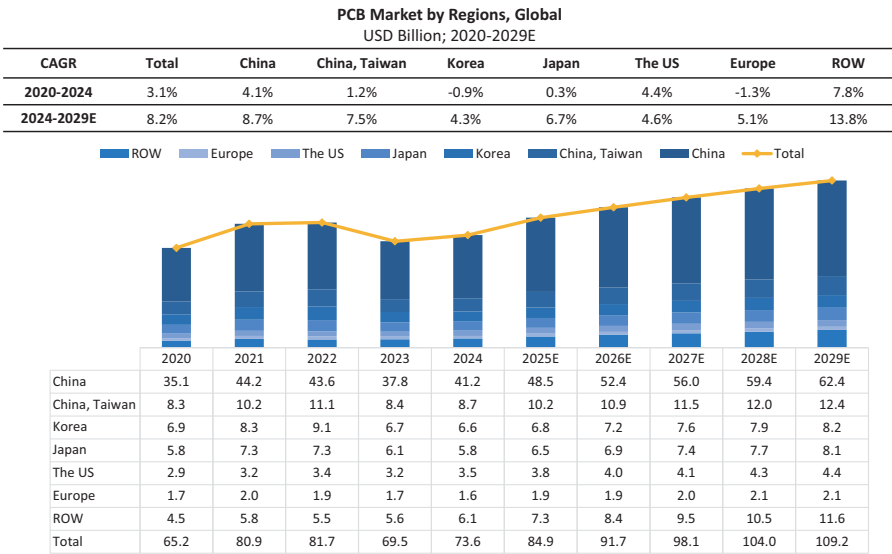
Source: Frost & Sullivan Analysis

Market Size of Global PCB Market

The global PCB market size grew from approximately USD65.2 billion in 2020 to approximately USD73.6 billion in 2024. In 2021, the global economy rebounded sharply. Besides, PCB manufacturers launched capacity expansions and stockpiled inventory to guard against supply disruptions. Thirdly, remote work and online learning fuelled a surge in demand for electronic products. However, amid the global interest rate hike cycle in 2023, corporate financing costs rose substantially. Meanwhile, consumer confidence weakening resulted in a contraction in demand for electronic products. In addition, volatility in energy prices and heightened freight risks undermined supply stability. Thus, the global PCB market was constrained. Driven by representative downstream industries including AI, High-Performance Computing (HPC) and communications infrastructure, both the output and unit prices of PCB products will witness sustained growth. By 2029, the global PCB market size is expected to reach approximately USD109.2 billion.

The Chinese PCB market size increased from approximately USD35.1 billion in 2020 to approximately USD41.2 billion in 2024, accounting for 56.0% of the global total, registering a CAGR of around 4.1% over the period. China's large-scale domestic electronics industry provides strong support for the demand of mid-to-low-end PCB products. Moreover, against the backdrop of marked advances in local production technologies and rising localization rates of premium PCB products, the market performance of high-end products will also be further strengthened. Accordingly, the Chinese PCB market size is forecast to hit approximately USD62.4 billion by 2029, accounting for 57.2% of the global total, with a CAGR of around 8.7% in the 2024-2029 period.

INDUSTRY OVERVIEW



Notes: The market size refers to the output value of PCB products in corresponding region.

Source: Frost & Sullivan Analysis and Estimates

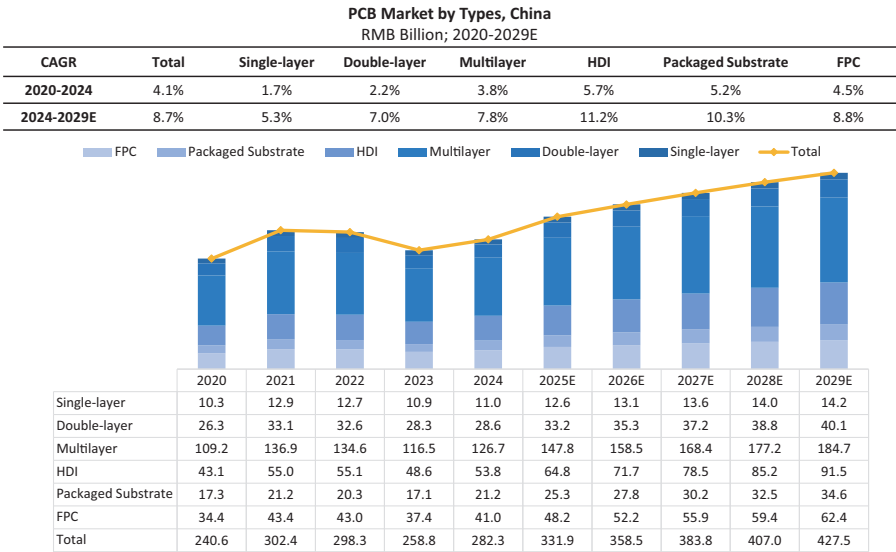
Market Size of China’s PCB Market

China’s PCB market exhibits a multi-tiered and structured development pattern, with different products playing distinct roles due to technical characteristics. For single-layer and double-layer PCBs, China boasts a fully integrated industrial chain system compared with overseas counterparts, which delivers notable cost advantages, higher product yield, and faster product iteration cycles. Consequently, the market size of China’s single-layer PCBs and double-layer PCBs grew from approximately RMB10.3 billion and RMB26.3 billion respectively in 2020 to around RMB11.0 billion and RMB28.6 billion in 2024, and is expected to further rise to about RMB14.2 billion and RMB40.1 billion in 2029, accounting for 74.4% and 85.7% of the global market, respectively.

Multilayer PCBs are widely applied in a variety of key fields including mid-to-high-end smartphones, new energy vehicles, industrial frequency converters and 5G base stations. By 2024, the market size of multilayer PCBs had reached approximately RMB126.7 billion. Driven by the pursuit of higher performance and higher reliability, the demand for higher-layer-count multilayer PCBs is rising significantly, propelling the continuous upgrading of the multilayer PCB market towards high-end segments. It is estimated that by 2029, the market size of China’s multilayer PCBs will grow to about RMB184.7 billion, with a CAGR of around 7.8% in the 2024 to 2029 period.

INDUSTRY OVERVIEW

The growth of market size of China’s HDI PCBs has been fuelled by rising demand across multiple downstream sectors. Consumer electronics are pursuing slimmer and lighter designs while requiring high-speed data transmission and compatibility with more functional modules. In the communications field, the requirements for low-loss signal transmission from high-speed optical modules and edge computing devices have also boosted the development of HDI PCBs. Automotive sectors have also started to widely adopt HDI PCBs, and the functions of HDI products will directly determine the level of automotive intelligence. It is projected that by 2029, the market size of HDI PCB products will hit about RMB91.5 billion, with a CAGR of around 11.2% from 2024 to 2029.



Notes: The market size refers to the output value of corresponding type of PCB products.

Source: Frost & Sullivan Analysis and Estimates

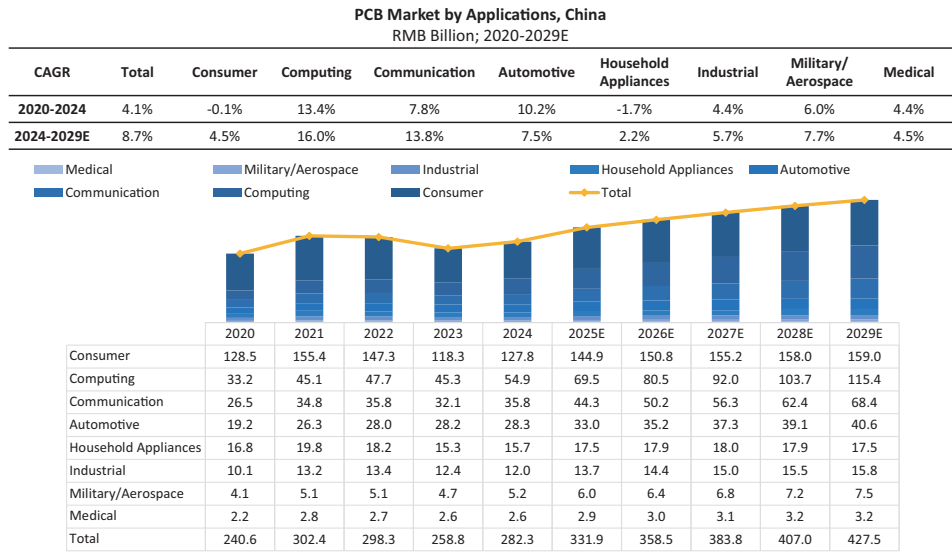
Driven by the development stage, technical characteristics, and demand scale of different downstream industries, the market has formed a differentiated pattern in terms of segment share and growth performance.

Consumer electronics underpin a steady demand for PCB, with China being the world’s largest production base. The consumer sector boasts solid stock replacement demand, while the prominent trends toward slimmer, multi-functional and high-performance products have driven up the PCB value per unit product. Beyond traditional mainstay products, AI terminals are also emerging as new growth drivers. It is projected that the market size of consumer PCBs will grow from approximately RMB127.8 billion in 2024 to around RMB159.0 billion in 2029, representing a CAGR of approximately 4.5% over the period, and will remain the largest segment in the PCB industry.

INDUSTRY OVERVIEW

Fuelled by the exponential growth in global demand for AI large model training and inference, the market size of computing PCBs surged from roughly RMB33.2 billion in 2020 to about RMB54.9 billion in 2024, with a CAGR of around 13.4% over the period, making it the fastest-growing segment in China’s PCB market. Bolstered by policy support, notable trends including data center construction, product upgrading and localization substitution will propel the market to maintain high-speed growth. It is estimated that by 2029, the market size of computing PCBs will further climb to approximately RMB115.4 billion, with a CAGR of around 16.0% during the 2024 to 2029 period.

The market size of automotive PCBs expanded from approximately RMB19.2 billion in 2020 to roughly RMB28.3 billion in 2024, which makes it the second-fastest-growing segment in China’s PCB market. With the rapid development of new energy vehicles and intelligent driving, both the vehicle electrification rate and intelligence level have improved significantly. Core components such as advanced driver assistance systems (ADAS), battery management systems (BMS), and on-board chargers (OBC) have driven a simultaneous increase in PCB usage volume and unit PCB value per vehicle. It is projected that by 2029, the market size of automotive PCBs will rise to around RMB40.6 billion, accounting for approximately 16.0% of China’s overall PCB market.



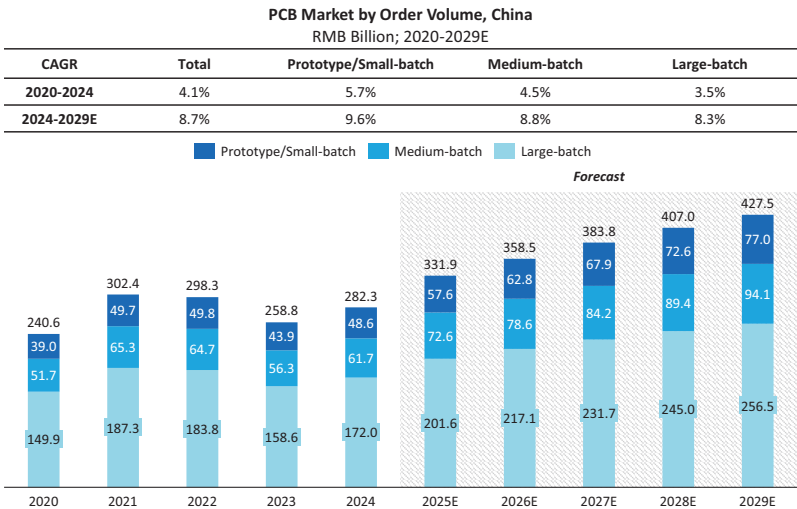
Notes: The market size refers to the output value of PCB products in corresponding downstream scenarios.

Source: Frost & Sullivan Analysis and Estimates

INDUSTRY OVERVIEW

Given the higher production costs of prototype/small-batch manufacturing, coupled with the requirement for PCB enterprises to provide integrated services including rapid response, customized processes and technical collaboration, prototype/small-batch orders accounts for a limited share of the market. Nevertheless, due to the accelerated R&D and innovation in downstream application industries, the surging demand for prototyping, and the increased degree of demand fragmentation, the demand for prototype/small-batch orders has been on the rise. Thereby, the market size of prototype/small-batch orders grew from approximately RMB39.0 billion in 2020 to around RMB48.6 billion in 2024, representing a CAGR of approximately 5.7% over the period. It is anticipated that by 2029, the market size will grow to approximately RMB77.0 billion, with a CAGR of around 9.6% from 2024 to 2029, accounting for approximately 18.0% of the overall PCB market.

The backdrop of accelerated iteration and shortened product life cycles leads to compressed R&D cycles and rising inventory risks for downstream industries. This has imposed higher requirements on PCB enterprises for rapid response, on-demand supply and flexible delivery to enhance the connection between R&D, pilot production and mass production. Despite the advantages of standardization and cost efficiency, the large-batch production model is constrained by limited flexibility. In contrast, medium-batch orders are increasingly emerging as a key track for manufacturers to achieve differentiated competition. It is estimated that the medium-batch PCB market will grow from approximately RMB61.7 billion in 2024 to around RMB94.1 billion in 2029.



Notes: The market size refers to the output value of PCB products that meet the corresponding order size.

Source: Frost & Sullivan Analysis and Estimates

INDUSTRY OVERVIEW

COMPETITIVE LANDSCAPE OVERVIEW

The PCB industry in China features a concentrated top-tier structure and a clearly differentiated enterprise echelon, which can be attributed to the following factors. First, high-end products feature high technical barriers, meaning such products can only be supplied by a limited number of manufacturers. Meanwhile, leading PCB manufacturers have established deeply bonded partnerships with top players in downstream industries including consumer electronics, communications and automotive, securing large-scale and stable orders. Additionally, national policies impose restrictions on low-end capacity. Leading enterprises have further expanded their scale and enhanced their technological capabilities through mergers and acquisitions, thereby continuously strengthening their market influence. In 2024, the top five PCB suppliers in China accounted for 36.3% of the total market share. With revenue of RMB970.6 million, our company ranked 42nd nationwide.

The Yangtze River Delta (YRD) stands as one of the core regions for China’s domestic PCB industry, where many PCB manufacturers have laid out their business operations. The YRD is endowed with abundant scientific research and talent resources, and boasts a stable production capacity for electronic-grade materials and high-purity chemicals. Besides, the YRD hosts a cluster of prominent automotive, consumer electronics and semiconductor industries, featuring a massive domestic demand market. Furthermore, the YRD is equipped with a comprehensive transportation infrastructure, which enables lower transportation costs and higher transportation efficiency for raw materials and finished products. Meanwhile, a more sophisticated financial system guarantees unimpeded financing channels for enterprises, providing strong support for their research and development as well as capacity expansion initiatives. Among all PCB suppliers based in the YRD, our company ranked the 6th, holding a market share of 0.3% in the China’s PCB market in 2024.

Ranking of the Leading PCB Suppliers, YRD, 2024
by Revenue, RMB Million

Ranking	Company	Revenue ⁽¹⁾	Market Share ⁽²⁾
1	Company A ⁽³⁾	24,800.8	8.8%
2	Company B ⁽⁴⁾	12,838.9	4.5%
3	Company C ⁽⁵⁾	3,219.0	1.1%
4	Company D ⁽⁶⁾	1,250.0	0.4%
5	Company E ⁽⁷⁾	1,191.3	0.4%
6	Our Company	970.6	0.3%
7	Company F ⁽⁸⁾	853.5	0.3%
8	Company G ⁽⁹⁾	550.8	0.2%
9	Company H ⁽¹⁰⁾	430.0	0.2%
10	Company I ⁽¹¹⁾	390.0	0.1%
Top10	N/A	46,495.0	16.5%

INDUSTRY OVERVIEW

Notes:

- (1) The revenue refers to the operating revenue generated by the PCB business segment.
- (2) Denominator of the percentage is the total output value of PCB products in China.
- (3) Company A is a company listed on the Shenzhen Stock Exchange, established in 1998, headquartered in Suzhou, Jiangsu Province. It is mainly engaged in the research and development, production, and sales of electronic circuit products, precision components, touch display modules, LED display devices, etc. Its products are applied in consumer electronics, new energy vehicles, communication equipment, industrial equipment, AI, medical equipment and other industries.
- (4) Company B is a company listed on the Shenzhen Stock Exchange, established in 1992, headquartered in Kunshan, Jiangsu Province. It is engaged in the research and development, production, sales, and related after-sales services of various PCBs. Its products are applied in various fields such as communication equipment, automobiles, industrial equipment, data centers, network communication, microwave RF, semiconductor chip testing, etc.
- (5) Company C is a company listed on the Shanghai Stock Exchange, established in 1993 and headquartered in Shanghai. Its main products are HDI, multilayer PCBs, rigid-flex PCBs, and other personalized customized PCBs, which can be applied in fields such as mobile intelligent terminals, 5G wireless communication base stations, data centers, optical modules, industrial control, medical, intelligent car products, and wearable consumer electronics.
- (6) Company D is a private company established in 2010, headquartered in Suzhou, Jiangsu Province. It focuses on the research, design, and production of FPCs and rigid-flex PCBs, while also expanding SMT mounting business. Its products are applied in communication, camera modules, display modules, wearable devices, automotive electronics, and substrate boards.
- (7) Company E is a listed company on the Shanghai Stock Exchange, established in 2005, headquartered in Changzhou, Jiangsu Province. Its main products are customized single/double-layer PCBs, multilayer PCBs, HDI PCBs, etc. Its products are mainly used in fields such as smart homes, automotive electronics, new energy, consumer office, industrial control/medical/EMS, communication and security.
- (8) Company F is a listed company on the Shanghai Stock Exchange, established in 2000, headquartered in Changzhou, Jiangsu Province. It is engaged in the research and development, production, sales, and SMT business of single-layer, double-layer, and multilayer PCBs. It mainly produces products in the fields of automotive electronics and high-frequency communication.
- (9) Company G is a listed company on the Shanghai Stock Exchange, established in 2000, headquartered in Nanjing, Jiangsu Province. It produces single-layer, double-layer, and multilayer PCBs, with communication equipment, automotive electronics, and new energy as core application areas, while covering industrial control, power, medical equipment, and other fields.
- (10) Company H is a private company established in 1992, headquartered in Shanghai. Its products are mainly used in the fields of automotive, industrial control, medical, 4G/5G communication, elevators, power supply, etc., and are supplied to domestic and overseas regions such as Japan.
- (11) Company I is a private company established in 2014, headquartered in Tongling, Anhui Province. Its main products include double-layer PCBs and multilayer PCBs, mainly serving domestic and foreign automotive companies, while also being applied in communication, household appliances, industrial control, and medical fields.

INDUSTRY OVERVIEW

Growth Drivers of China’s PCB Market

Continuous Innovations in Cutting-edge Technologies Multiply the Value of PCB Products

Currently, the PCB industry is evolving into a divergence characterized by acute shortages in high-end segments and mounting operational pressure in low-end markets. Consequently, profit margins and growth drivers are increasingly concentrating among leading enterprises that command proprietary high-end technologies. For instance, AI servers necessitate the deployment of high-layer-count PCBs with 18 or more layers to support complex computing architectures. This structural shift is not only reshaping the industry’s competitive landscape but also underscoring that technological leadership has become the key driver of sustainable growth for PCB enterprises.

The Expansion of Key End-use Applications Propels PCBs toward Volume and Value Growth

PCBs are experiencing robust growth against the backdrop of the rapid development of pivotal end-use sectors. The explosive proliferation of AI has triggered a sharp surge in demand for increased layer counts, narrower line widths, and tighter line spacings. New energy vehicles (NEVs) require complex electronic systems such as battery management systems, motor controllers, on-board chargers, and ADAS, driving a rapid uptick in PCB value per vehicle. As communication base stations evolve toward higher frequency bands, antenna density, and signal processing complexity, PCBs will upgrade in high-frequency and high-speed materials as well as larger deployment volumes.

Geopolitical Dynamics and Cost Considerations Restructure Global PCB Supply Chains

With the rapid growth of China’s chip industries, combined with multiple national policies introduced to guide and support the high-end development of the domestic PCB industrial chain, domestic PCB enterprises have ramped up R&D investment significantly, gradually establishing a fully independent and controllable industrial chain. This shift has driven the industry to transition from a scale-oriented growth model to one that balances both quality and scale. Furthermore, domestic PCB companies are exploring “Domestic R&D Plus Southeast Asian Production” model, retaining high-end PCB manufacturing processes domestically while optimizing labor costs, enhancing vertical industrial chain integration, and improving logistics efficiency.

Entry Barriers of China’s PCB Market

Technical Barriers Arising from Process Precision and Material Mastery

The PCB industry is a typical technology-intensive sector, where leading enterprises can leverage their technological superiority to build a generational edge in core domains. For instance, ensuring process precision requires reliance on high-value equipment such as laser direct imaging (LDI) systems, laser drilling machines, and vacuum lamination tools, coupled with years of accumulated industry expertise and operational know-how. Meanwhile, different application fields impose divergent requirements on parameters including thickness, aperture size, and thermal conductivity. Enterprises must master full-range technologies to meet customers’ diversified demands, while further improving yield rates.

INDUSTRY OVERVIEW

Capital and Scale Barriers Spanning Construction, Operation and R&D

In the initial investment phase, enterprises face substantial costs for production line construction. Critical equipment still relies partially on imports, translating into even higher capital input. Moreover, the procurement and commissioning cycle of such equipment lengthens the ROI cycle and further squeezes profit margins for new market players. In the operational phase, sustained capital injection is required for equipment upgrading and process optimization to keep pace with downstream technological upgrades. In production, mass PCB manufacturing demands standardized production capabilities to dilute unit costs, while the prototype/small-batch segment requires digital platforms to enhance operational efficiency. As a result, capital-constrained enterprises struggle to gain competitiveness, driving a continuous increase in industry concentration.

Ecological Barriers from Highly Integrated Collaboration Across the Industrial Chain

Raw materials in upstream account for about 30% of the cost structure, and leading enterprises can effectively control procurement costs by establishing long-term strategic partnerships with core suppliers. And multiple downstream segments of the PCB industry feature long and rigorous certification cycles. Once certified, customers tend to maintain long-term partnerships, as switching suppliers entails repeating the certification process and incurring potential quality risks. This stability enables early market entrants to build a solid ecological moat. Additionally, the PCB market exhibits distinct regional characteristics, where enterprises usually form deeply integrated partnerships with downstream giants within their core operating regions to ensure supply chain stability.

Future Trends of China’s PCB Market

Upgrading of Technology Routes and Product Structure

Driven by downstream high-end demand, PCBs will undergo continuous iteration toward high-end manufacturing processes, high value-added features, ultra-high layer counts and ultra-large dimensions, while the space for low-end homogeneous products will keep shrinking. R&D efforts will focus on cutting-edge technologies such as ultra-fine circuit processing, any-layer interconnection, and expanded application of high-frequency and high-speed materials. These initiatives will cater to the miniaturization, high integration and high-speed transmission requirements of premium end products including millimetre-wave radars and AI servers.

Flexibilization and Digitalization of Production Models

As downstream feature shorter iteration cycles and growing customized demands, PCB enterprises are proactively transforming their production models. They are deploying flexible production lines to reduce product changeover time and improve responsiveness to multi-variety, small-batch orders. Additionally, they are increasing investment in smart manufacturing, leveraging industrial internet and big data analytics to achieve real-time production process monitoring, process parameter optimization and product yield prediction. What’s more, enterprises will expand business portfolios and enhance market competitiveness by offering value-added services such as high-speed simulation, thermal analysis and design for manufacturability optimization.

INDUSTRY OVERVIEW

Accelerated Differentiation of Market Competition Pattern

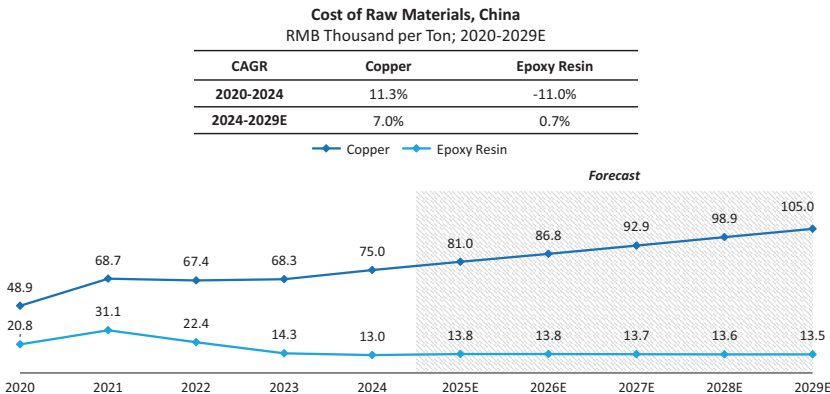
Internationally, leading enterprises will continue to dominate the market by virtue of their technological reserves, customer binding effects and production capacity advantages. Domestically, Chinese enterprises are facing dual opportunities of localization substitution and high-end upgrading, and will achieve breakthroughs in key materials and equipment, while backward production capacity will be phased out continuously. The domestic regional competition pattern will be further strengthened relying on the industrial cluster effects of the Yangtze River Delta and Pearl River Delta. Finally, the relationship between upstream and downstream industrial chains will shift from simple procurement to joint R&D, with the level of supply chain collaboration deepening steadily.

Cost of Raw Materials Analysis

As key raw materials for the PCB industry, copper foil and resin see their price fluctuations directly passed on to CCL manufacturers and further impact the prices of finished PCB products.

Copper serves as the critical carrier for current transmission in PCBs. Subject to the macro interest rate hike and cut cycles, geopolitical factors and other influences since 2020, the price of copper has surged to RMB81.0 thousand per ton in 2024. Driven by the continuous rise in ore mining costs, frequent supply-side disruptions, as well as the robust demand for copper from downstream sectors, copper prices are projected to climb further to RMB105.0 thousand per ton by 2029.

Resin acts as the carrier for insulation, adhesion and signal transmission in PCBs. After 2020, propelled by the sharp price increases of bisphenol A (BPA) and epichlorohydrin (ECH) on the cost side and strong downstream demand, the price of epoxy resin rose rapidly to a peak. With the excess supply of newly-added raw material production capacity in 2022, the price of epoxy resin dropped to RMB13.0 thousand per ton. As the industry gradually undergoes integration, the price is expected to remain basically stable, reaching approximately RMB13.5 thousand per ton by 2029.



Notes: The cost refers to the annual average spot price.

Source: Frost & Sullivan Analysis and Estimates