

Chapter 12: Substrates and PCBs

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26 Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 20 [\[A\]](#)
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4 Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 4 [\[A\]](#)
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32 Apple and Qualcomm fret over strained supplies of Japan's glass cloth. Nikkei Asia · 14 January 2026 [\[B\]](#)
asia.nikkei.com/business/technology/tech-asia/apple-and-qualcomm-fret-over-strained-supplies-of-japan-s-glass-cloth

33 Ibidem, questions and answers from the financial presentation for the first quarter of the year ending 31 March 2027. Ibidem · 5 August 2026 [\[A\]](#) www.ibiden.com/ir/items/en_QA_FY2026Q1.pdf

Substrates and PCBs

Ajinomoto, a Japanese food company, told investors in June 2026 that it holds over 95 percent of the market for the insulating film inside high-end chip packages.

IN PLAIN TERMS

A package substrate is the adapter between a chip and the circuit board under it. The chip's connections are finer than a human hair, but the board is wired in millimeters. The substrate is built in layers, like plywood, around a stiff core of glass cloth and resin. Thin sheets of epoxy film are pressed onto both faces of the core. A laser burns holes through each sheet, and copper plated into the holes carries signals from one layer to the next. Every added layer is another set of holes that can fail. A handful of firms build these substrates. Japan's Ajinomoto dominates the film, and Japan's Nitto Boseki dominates the low-expansion glass cloth in the core.

IN SHORT

Ajinomoto's third site for making its build-up film, in Gifu Prefecture, is scheduled to start operating in 2032 to meet demand after 2030 ²⁶. Nitto Boseki says market demand seems to have risen about two to three times since it set its plan for fiscal 2024 to 2027 ⁴. In January 2026 Nikkei Asia reported that Apple and Qualcomm were among the customers worried about Japanese glass cloth supply ³². In August 2026 Ibiden said it had prospects of a third and fourth glass cloth supplier and expected its material procurement risks to decrease ³³.

26 Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 20 ^[A]
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4 Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 4 ^[A]
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32 Apple and Qualcomm fret over strained supplies of Japan's glass cloth. Nikkei Asia · 14 January 2026 ^[B]
asia.nikkei.com/business/technology/tech-asia/apple-and-qualcomm-fret-over-strained-supplies-of-japan-s-glass-cloth

33 Ibiden, questions and answers from the financial presentation for the first quarter of the year ending 31 March 2027. Ibiden · 5 August 2026 ^[A] www.ibiden.com/ir/items/en_QA_FY2026Q1.pdf

CHOKEPOINT CARD		EXTREME CONCENTRATION	HARD TO SUBSTITUTE
CONCENTRATION	SUBSTITUTABILITY		PRICE OR MARKET SIZE
Extreme	Hard		\$7.5 billion
	Rated on the insulating film inside the substrate, because chipmakers and device makers would have to approve any rival film before using it ¹ .		market for FC-BGA substrates in 2025, up 18 percent, in a Prismark estimate cited by AT&S ²
WHO LEADS	JP Ajinomoto Told investors in June 2026 that its build-up film has held over 95% of its market since launch³ JP Nitto Boseki Claimed an overwhelming advantage in low thermal expansion glass in its 2025 integrated report⁴ JP Ibiden Said in May 2026 that it typically takes close to 100% of each new generation of interposer-type substrates at launch⁵ TW Unimicron Build-up substrates were 52% of sales in Q2 2026⁶ KR Samsung Electro-Mechanics Package solution sales KRW 771.6bn in Q2 2026, up 37%⁷		
WHERE IT IS MADE	JP Japan Build-up film, low-expansion glass cloth, Ibiden and Shinko substrate plants in Gifu and Nagano TW Taiwan Unimicron and Nan Ya PCB, substrate makers that sell to outside customers KR South Korea Samsung Electro-Mechanics and a planned glass-core joint venture with Sumitomo Chemical's Dongwoo Fine-Chem CN China Most of TTM's circuit board competitors are based in China and Taiwan AT Austria AT&S		
WHY SUBSTITUTION IS SLOW	Ajinomoto makes the thin insulating film between the substrate's wiring layers ⁸ . Chipmakers and device makers approve substrate materials such as laminate, so a rival film would need their approval too ¹ .		
WHERE CHINA STANDS	WHERE THE US STANDS		
TTM, an American circuit board maker, said in its annual report for 2025 that its circuit board competitors are mostly based in China and Taiwan ⁹ . Nitto Boseki, a Japanese glass fiber maker, said in its 2025 integrated report that Chinese and Taiwanese companies are aggressively catching up with it in the special glass	The White House's 2021 supply chain review listed no American firm among the key substrate makers ¹⁰ . In December 2024 the Commerce Department finalized an award of up to \$75 million to Absolics, an affiliate of Korea's SKC, for a glass substrate plant in Covington, Georgia ¹¹ .		

¹ Electronics Materials Business⁴ (Mitsubishi Gas Chemical business briefing). Mitsubishi Gas Chemical · 2 October 2024 · p. 12

² AT&S Annual Report 2025/26. AT&S · 10 June 2026 · p. 33 [A](#) ats.net/en/download/annual-report-2025-26/?wpdmcl=61788#page=33

³ Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 3 [A](#) www.ajinomoto.co.jp/company/en/ir/event/business_briefing/main/011117/teaserItems1/01/linkList/03/link/20260630_presentation_E.pdf#page=3

⁴ Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 4 [A](#) www.nittobo.co.jp/eng/ir/pdf/Nittobo_Integrated-Report_2025.pdf#page=4

The silicon interposer wires chips together inside a package. Beyond the interposer, the wiring runs through a build-up substrate made of epoxy and glass, then a printed circuit board of thirty layers, then a server rack.

How it works

The substrate maker drills the core and plates it with copper before the build-up starts. In each cycle the maker then presses on a film of epoxy, burns holes through it with a laser to connect the layers, and adds copper wiring on top ¹². Each film is about 10 micrometers thick, and a human hair is about 80 micrometers across ¹³.

Ajinomoto counts 11 layers of its film on each side of the core in a 2026 AI package substrate about 100 mm square ¹⁴. A high-performance computing substrate about 70 mm square had nine on each side around 2023 ¹⁴. PC substrates had three layers of the film on each side when PCs first adopted it in 1999 ¹⁴. Silicon and epoxy expand at different rates when heated, so the larger the package, the more it warps. Nitto Boseki says its low-expansion T-glass cloth is highly rated as an

5 Ibidem, questions and answers from the financial presentation for the year ended 31 March 2026. Ibidem · 12 May 2026 [A]
www.ibiden.com/ir/items/en_QA_FY25Q4.pdf

6 Unimicron 2026 Q2 Earnings Conference. Unimicron Technology · July 2026 [A] www.unimicron.com/files/money/Earnings/en/2026-Q2-consolidated-en.pdf

7 Samsung Electro-Mechanics, Q2 2026 business results. Samsung Electro-Mechanics · 30 July 2026 [A]
m.samsungsem.com/global/newsroom/news/view.do?id=10462

8 Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 9 [A]
www.ajinomoto.co.jp/company/en/ir/event/business_briefing/main/011117/teaserItems1/01/linkList/03/link/20260630_presentation_E.pdf#page=9

11 Electronics Materials Business (Mitsubishi Gas Chemical business briefing). Mitsubishi Gas Chemical · 2 October 2024 · p. 12 [A]
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9 TTM TECHNOLOGIES INC, Form 10-K annual report for the period ended 2025-12-29 (10-K). U.S. Securities and Exchange Commission (filing by TTM TECHNOLOGIES INC) · 17 February 2026 [A]
www.sec.gov/Archives/edgar/data/1116942/000119312526051976/ttmi-20251229.htm

4 Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 4 [A]
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10 Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth: 100-Day Reviews under Executive Order 14017. The White House (Biden administration archive) · June 2021 · p. 43 [A]
bidenwhitehouse.archives.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf#page=43

11 Biden-Harris Administration Announces CHIPS Incentives Awards with Absolics and Entegris to Support Development of Advanced Packaging Technology and Onshore Material for Leading-Edge Chip Production. NIST · 5 December 2024 [A]
www.nist.gov/news-events/news/2024/12/biden-harris-administration-announces-chips-incentives-awards-absolics-and

12 Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 18 [A]
www.ajinomoto.co.jp/company/en/ir/event/business_briefing/main/011117/teaserItems1/01/linkList/03/link/20260630_presentation_E.pdf#page=18

13 The Ajinomoto Group's Unexpected Role in Semiconductor Manufacturing: The Insulating Film "ABF" Born from "AminoScience". Ajinomoto · 5 March 2026 [A] www.ajinomoto.com/stories/the-ajinomoto-groups-unexpected-role-in-semiconductor-manufacturing-the-insulating-film-abf-born-from-aminoscience

14 Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 11 [A]
www.ajinomoto.co.jp/company/en/ir/event/business_briefing/main/011117/teaserItems1/01/linkList/03/link/20260630_presentation_E.pdf#page=11

effective fix for that warping, and that its use in substrates has increased significantly ¹⁵.

Variants and trade-offs

BT substrates

Substrates built on bismaleimide-triazine laminate, or BT, are the other main family. Mitsubishi Gas Chemical, which makes BT materials, says they go mostly into thin packages for smartphone processors, radio modules and memory ¹⁶. The company says BT also goes into flip-chip substrates for computer CPUs and GPUs ¹⁶. In these the chip is mounted face down, and BT laminate forms the core between layers of build-up film ¹⁷. In an October 2024 investor presentation, the company estimated that its BT resins held about 40 percent of the substrate materials market ¹⁸.

ABF build-up substrates

Ajinomoto Build-up Film, or ABF, is the insulating film between the layers of package substrates for logic chips, used in PCs, network equipment, servers and AI equipment ⁸. Ajinomoto first developed it in 1999 and says major chipmakers have used it as the de facto standard ever since ¹⁹. On Ajinomoto's own site, its electronic materials division said practically all high-performance computers and servers rely on the film ¹³. In June 2026 Ajinomoto told investors that the film has held a share of over 95 percent since its launch ³.

15 Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 17 [\[A\]](https://www.nittobo.co.jp/eng/ir/pdf/Nittobo_Integrated-Report_2025.pdf#page=17)

16 Electronics Materials Business (Mitsubishi Gas Chemical business briefing). Mitsubishi Gas Chemical · 2 October 2024 · p. 16 [\[A\]](https://www.mgc.co.jp/eng/ir/files/2410022e.pdf#page=16)

17 Electronics Materials Business (Mitsubishi Gas Chemical business briefing). Mitsubishi Gas Chemical · 2 October 2024 · p. 18 [\[A\]](https://www.mgc.co.jp/eng/ir/files/2410022e.pdf#page=18)

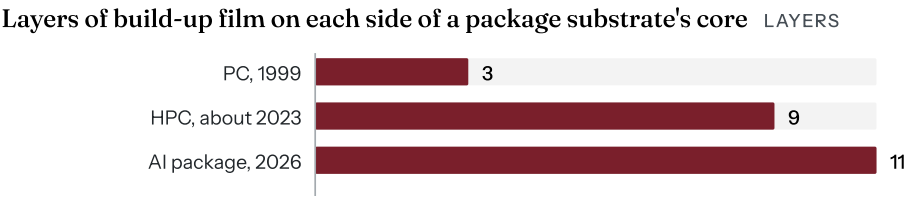
18 Electronics Materials Business (Mitsubishi Gas Chemical business briefing). Mitsubishi Gas Chemical · 2 October 2024 · p. 11 [\[A\]](https://www.mgc.co.jp/eng/ir/files/2410022e.pdf#page=11)

8 Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 9 [\[A\]](https://www.ajinomoto.co.jp/company/en/ir/event/business_briefing/main/011117/teaserItems1/01/linkList/03/link/20260630_presentation_E.pdf#page=9)

19 Ajinomoto, Business Briefing: ABF-Based Growth Strategy in ICT, 12 June 2023. Ajinomoto · 12 June 2023 · p. 4 [\[A\]](https://www.ajinomoto.co.jp/company/en/ir/event/business_briefing/main/011113/teaserItems1/01/linkList/00/link/3_ICT_E.pdf#page=4)

13 The Ajinomoto Group's Unexpected Role in Semiconductor Manufacturing: The Insulating Film "ABF" Born from "AminoScience". Ajinomoto · 5 March 2026 [\[A\]](https://www.ajinomoto.com/stories/the-ajinomoto-groups-unexpected-role-in-semiconductor-manufacturing-the-insulating-film-abf-born-from-aminoscience)

3 Ajinomoto, Growth Strategy for the Electronic Materials Business, 30 June 2026. Ajinomoto · 30 June 2026 · p. 3 [\[A\]](https://www.ajinomoto.co.jp/company/en/ir/event/business_briefing/main/011117/teaserItems1/01/linkList/03/link/20260630_presentation_E.pdf#page=3)



Source: Ajinomoto, Growth Strategy for the Electronic Materials Business, June 2026

Glass core substrates

A glass core expands less with heat than a resin core and stays flatter, so chipmakers and substrate makers are both trying it ²⁰.

- **Absolics**, a subsidiary of Korea's SKC, has a final Commerce Department award of up to \$75 million for a 120,000-square-foot glass substrate plant in Covington, Georgia ²¹. The department finalized the award in December 2024 ¹¹. As of October 2026, the award's project page at NIST, a Commerce Department agency, expected first deliveries to customers in 2025 and production capacity to come online in 2027 ²¹.
- **Intel** announced glass substrates in September 2023 for the latter part of this decade ²².
- **Samsung Electro-Mechanics** signed a joint venture agreement with Sumitomo Chemical's subsidiary Dongwoo Fine-Chem in July 2026 to make glass core substrates ²³. The partners plan to have a supply system in place by the second half of fiscal 2027 ²³.

20 Samsung Electro-Mechanics Signs MOU with Sumitomo Chemical Group to Establish a Joint Venture for Glass Core Used in Package Substrates. Samsung Electro-Mechanics · 5 November 2025 [\[A\]](https://samsungsem.com/global/newsroom/news/view.do?id=9850) samsungsem.com/global/newsroom/news/view.do?id=9850

21 Absolics (Georgia). NIST · 5 July 2024 [\[A\]](https://www.nist.gov/chips/absolics-georgia-covington) www.nist.gov/chips/absolics-georgia-covington

11 Biden-Harris Administration Announces CHIPS Incentives Awards with Absolics and Entegris to Support Development of Advanced Packaging Technology and Onshore Material for Leading-Edge Chip Production. NIST · 5 December 2024 [\[A\]](https://www.nist.gov/news-events/news/2024/12/biden-harris-administration-announces-chips-incentives-awards-absolics-and-entegris) www.nist.gov/news-events/news/2024/12/biden-harris-administration-announces-chips-incentives-awards-absolics-and-entegris

22 Intel Unveils Industry-Leading Glass Substrates to Meet Demand for More Powerful Compute. Intel · 18 September 2023 [\[A\]](https://download.intel.com/newsroom/archive/2025/en-us-2023-09-18-intel-unveils-industry-leading-glass-substrates-to-meet-demand-for-more-powerful-compute.pdf) download.intel.com/newsroom/archive/2025/en-us-2023-09-18-intel-unveils-industry-leading-glass-substrates-to-meet-demand-for-more-powerful-compute.pdf

23 Sumitomo Chemical Subsidiary to Establish of a Joint Venture with Samsung Electro-Mechanics for the Glass Core Substrate Business. Sumitomo Chemical · 2 July 2026 [\[A\]](https://www.sumitomo-chem.co.jp/english/news/detail/20260702e_2.html) www.sumitomo-chem.co.jp/english/news/detail/20260702e_2.html

The materials underneath

Ajinomoto's Healthcare and Others segment, which includes electronic materials such as the film, lifted business profit 45.1 percent to JPY 66.2 billion in the year to March 2026 ²⁴. Ajinomoto attributes the rise mainly to higher electronic materials revenue and higher profit in Bio-Pharma Services & Ingredients ²⁴. It has set an investment budget of JPY 25 billion between 2023 and 2030 to expand film production ²⁵. It says there are no concerns about its current supply chain overall ³. In May 2026 it announced the acquisition of land in Gifu Prefecture for a third production site, scheduled to start operating in 2032 to meet demand after 2030 ²⁶.

The glass cloth in the core also has a dominant supplier. Nitto Boseki's T-glass is stiff and expands little when heated, and the company calls it essential for making high-density package substrates ²⁷. Laminate makers such as Mitsubishi Gas Chemical coat the glass cloth with resin and press it with copper foil into the core laminate that substrate makers build on ²⁸.

Nitto Boseki claims an overwhelming advantage in quality and capacity for low-expansion glass ⁴. It planned about JPY 80 billion of capital spending for fiscal 2024 to 2027 ²⁹. It says market demand seems to have risen about two to three times since that plan was set ⁴. In August 2025 it decided to expand glass fiber cloth production at its Fukushima Enterprise Center, with production scheduled to begin in the fourth quarter of its fiscal 2026 ³⁰. In May 2026 it forecast capital investment of JPY 45,000 million for the year to March 2027, up from JPY 21,702 million in the year to March 2026 ³¹.

In January 2026 Nikkei Asia reported that Apple and Qualcomm were among the customers worried about Japanese glass cloth supply ³². In August 2026 Ibidem, a

24 Consolidated Financial Results for the Fiscal Year Ended March 31, 2026 (Under IFRS). Ajinomoto · 7 May 2026 · p. 8 [A](https://www.ajinomoto.co.jp/company/en/ir/library/result/main/014/teaserItems1/0/linkList/06/link/FY25Q4_Tanshin_E.pdf#page=8)

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4 Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 4 [A](https://www.nittobo.co.jp/eng/ir/pdf/Nittobo_Integrated-Report_2025.pdf#page=4)

29 Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 5 [A](https://www.nittobo.co.jp/eng/ir/pdf/Nittobo_Integrated-Report_2025.pdf#page=5)

30 Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 12 [A](https://www.nittobo.co.jp/eng/ir/pdf/Nittobo_Integrated-Report_2025.pdf#page=12)

31 Consolidated Financial Results for the Fiscal Year Ended March 31, 2026. Nitto Boseki (Nittobo) · 12 May 2026 · p. 5 [A](https://ssl4.eir-parts.net/doc/3110/ir_material_for_fiscal_ym2/202884/00.pdf#page=5)

32 Apple and Qualcomm fret over strained supplies of Japan's glass cloth. Nikkei Asia · 14 January 2026 [B](https://asia.nikkei.com/business/technology/tech-asia/apple-and-qualcomm-fret-over-strained-supplies-of-japan-s-glass-cloth)

Japanese substrate maker, said it had used only two glass cloth suppliers, in Japan and Taiwan, but now had prospects of a third and fourth for mass production³³. Because a Japanese supplier also plans to add capacity, Ibiden said it expected its material procurement risks to decrease³³.

Nitto Boseki says Chinese and Taiwanese companies are aggressively catching up with it in the special glass sector⁴. In July 2026 Nikkei Asia reported that Chinese chip materials makers were competing with Japanese rivals for a market that the industry association SEMI put at \$73.2 billion in 2025³⁴.

Who makes it

Most of the firms that build substrates for others are Asian. The White House's 2021 hundred-day supply chain review listed build-up substrate among the materials that commenters called vulnerable³⁵. It named key substrate makers including Ibiden, Nanya, Shinko, Samsung, Unimicron, Shennan Circuits, Zhuhai Yueya and AKM, none of them American¹⁰.

A May 2024 report by the Semiconductor Industry Association and Boston Consulting Group counted the major package substrate vendors by headquarters³⁶. It found two in Japan, two in Taiwan, one in mainland China and none in the United States³⁶. TTM Technologies, an American circuit board maker, says it also offers package substrates⁹.

- **Ibiden** will invest about JPY 500 billion in high-performance package substrates from fiscal 2026 to fiscal 2028, starting with about JPY 220 billion, mainly at its Gama plant in Gifu Prefecture³⁷. In August 2026 it said the Gama

33 Ibiden, questions and answers from the financial presentation for the first quarter of the year ending 31 March 2027. Ibiden · 5 August 2026 [\[A\]](https://www.ibiden.com/ir/items/en_QA_FY2026Q1.pdf) www.ibiden.com/ir/items/en_QA_FY2026Q1.pdf

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34 China chip material makers battle Japan rivals for \$73bn market. Nikkei Asia · 1 July 2026 [\[B\]](https://asia.nikkei.com/business/tech/semiconductors/china-chip-material-makers-battle-japan-rivals-for-73bn-market) asia.nikkei.com/business/tech/semiconductors/china-chip-material-makers-battle-japan-rivals-for-73bn-market

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36 Emerging Resilience in the Semiconductor Supply Chain. Boston Consulting Group and Semiconductor Industry Association · May 2024 · p. 19 [\[A\]](https://www.semiconductors.org/wp-content/uploads/2024/05/Report_Emerging-Resilience-in-the-Semiconductor-Supply-Chain.pdf#page=19) www.semiconductors.org/wp-content/uploads/2024/05/Report_Emerging-Resilience-in-the-Semiconductor-Supply-Chain.pdf#page=19

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37 Ibiden, Notice Regarding Capital Investment Plan for High-Performance IC Package Substrates. Ibiden · 3 February 2026 [\[A\]](https://www.ibiden.com/company/2026/02/notice-regarding-capital-investment-plan-for-high-performance-ic-package-substrates.html) www.ibiden.com/company/2026/02/notice-regarding-capital-investment-plan-for-high-performance-ic-package-substrates.html

plant was scheduled to start operating in stages from the end of fiscal 2027 and to add to its results from fiscal 2028 ³³. In May 2026 management said Ibiden typically takes close to 100 percent of a new generation of interposer-type substrates at launch ⁵. It added that this share may decline by 20 to 30 percent after about three to six months ⁵. On silicon-bridge substrates, it said wiring the underside is hard enough that Ibiden expects to keep its technical lead at least through fiscal 2030 ⁵.

- **Unimicron** reported NT\$42.9 billion of sales in the second quarter of 2026, 52 percent of it build-up substrates and 61 percent of it AI data center work ⁶.
- **Samsung Electro-Mechanics** grew package solution sales 37 percent year on year to KRW 771.6 billion in the second quarter of 2026, on substrates for AI accelerators, server processors and cars ⁷.
- **AT&S**, an Austrian firm, calls itself a globally leading maker of high-end package substrates ³⁸. It makes them in China and Malaysia, and since its 2025/26 financial year also in Austria ³⁹. Citing the research firm Prismark, its annual report for 2025/26 valued the market for flip-chip ball grid array (FC-BGA) substrates at \$7.5 billion in 2025, up 18 percent from 2024 ².

In February 2025 a company owned mainly by funds of JIC Capital, a subsidiary of Japan Investment Corporation, launched a tender offer to take Shinko, a Japanese substrate maker, private ⁴⁰. The offer covered the shares Fujitsu did not own, and Fujitsu agreed to sell its 50.02 percent stake back to Shinko ⁴¹. The tender offer succeeded in March 2025 ⁴².

In September 2026 Shinko agreed to buy a plant in Mobara, Chiba Prefecture, from Japan Display, a display maker ⁴³. Shinko said it would make the site a new core plant for its flip-chip package substrates and would also expand capacity at its

33 Ibiden, questions and answers from the financial presentation for the first quarter of the year ending 31 March 2027. Ibiden · 5 August 2026 [\[A\]](https://www.ibiden.com/ir/items/en_QA_FY2026Q1.pdf) www.ibiden.com/ir/items/en_QA_FY2026Q1.pdf

5 Ibiden, questions and answers from the financial presentation for the year ended 31 March 2026. Ibiden · 12 May 2026 [\[A\]](https://www.ibiden.com/ir/items/en_QA_FY25Q4.pdf) www.ibiden.com/ir/items/en_QA_FY25Q4.pdf

6 Unimicron 2026 Q2 Earnings Conference. Unimicron Technology · July 2026 [\[A\]](https://www.unimicron.com/files/money/Earnings/en/2026-Q2-consolidated-en.pdf) www.unimicron.com/files/money/Earnings/en/2026-Q2-consolidated-en.pdf

7 Samsung Electro-Mechanics, Q2 2026 business results. Samsung Electro-Mechanics · 30 July 2026 [\[A\]](https://m.samsungsem.com/global/newsroom/news/view.do?id=10462) m.samsungsem.com/global/newsroom/news/view.do?id=10462

38 AT&S Annual Report 2025/26. AT&S · 10 June 2026 · p. 67 [\[A\]](https://ats.net/en/download/annual-report-2025-26/?wpdmdl=61788#page=67) ats.net/en/download/annual-report-2025-26/?wpdmdl=61788#page=67

39 AT&S Annual Report 2025/26. AT&S · 10 June 2026 · p. 53 [\[A\]](https://ats.net/en/download/annual-report-2025-26/?wpdmdl=61788#page=53) ats.net/en/download/annual-report-2025-26/?wpdmdl=61788#page=53

2 AT&S Annual Report 2025/26. AT&S · 10 June 2026 · p. 33 [\[A\]](https://ats.net/en/download/annual-report-2025-26/?wpdmdl=61788#page=33) ats.net/en/download/annual-report-2025-26/?wpdmdl=61788#page=33

40 Announcement Regarding Commencement of the Tender Offer for the Shares of Shinko Electric Industries Co., Ltd. (Securities Code: 6967) by JICC-04, Ltd.. Japan Investment Corporation · 17 February 2025 · p. 1 [\[A\]](https://www.jicccapital.co.jp/en/news/assets/E_20250217_JIC_JICC_PressRelease.pdf#page=1) www.jicccapital.co.jp/en/news/assets/E_20250217_JIC_JICC_PressRelease.pdf#page=1

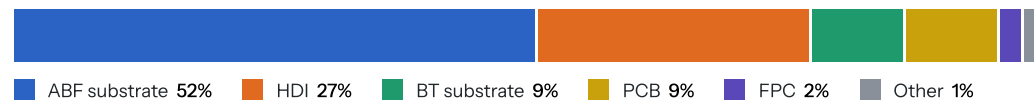
41 Announcement Regarding Commencement of the Tender Offer for the Shares of Shinko Electric Industries Co., Ltd. (Securities Code: 6967) by JICC-04, Ltd.. Japan Investment Corporation · 17 February 2025 · p. 3 [\[A\]](https://www.jicccapital.co.jp/en/news/assets/E_20250217_JIC_JICC_PressRelease.pdf#page=3) www.jicccapital.co.jp/en/news/assets/E_20250217_JIC_JICC_PressRelease.pdf#page=3

42 (Progress Report on Disclosed Matters) Notice Regarding Completion of JICC-04's Tender Offer for Shares of a Consolidated Subsidiary of Fujitsu Limited (SHINKO ELECTRIC INDUSTRIES CO., LTD.). Fujitsu · 19 March 2025 [\[A\]](https://pr.fujitsu.com/jp/news/2025/03/en/19-1.pdf) pr.fujitsu.com/jp/news/2025/03/en/19-1.pdf

43 Notice Concerning the Acquisition of Japan Display Inc.'s Mobara Fab. Shinko Electric Industries · 30 September 2026 [\[A\]](https://www.shinko.co.jp/english/news/docs/20260930-01_en.pdf) www.shinko.co.jp/english/news/docs/20260930-01_en.pdf

plants in Nagano ⁴³. Production at the Mobara plant is scheduled to start in fiscal 2028 ⁴³.

Unimicron sales by technology, second quarter 2026 %



Source: Unimicron 2026 Q2 earnings conference

The boards under the GPU

TTM Technologies says it regularly builds printed circuit boards of more than 30 layers and can go past 70 ⁹. Those layers carry power to the GPUs and route fast signals between them, so how much signal the laminate absorbs is a main design constraint. Nitto Boseki also makes NE-glass, a low-dielectric glass cloth that absorbs less signal, used in switches and routers in data centers ⁴⁴.

Data center computing was 24 percent of TTM's fiscal 2025 revenue of about \$2.9 billion, against 14 percent two years earlier ⁹. TTM says its circuit board competitors are mostly based in China and Taiwan ⁹. In its annual report for 2025, TTM said it was building a plant in Syracuse, New York, to make ultra-high-density circuit boards for national security needs ⁹. It expected volume production there in the second half of 2026 ⁹. Thailand aims to be the biggest circuit board hub outside China as board makers diversify production ⁴⁵.

The chokepoint

The few firms that build substrates are spending to add capacity, but it takes years. In August 2026 Ibiden said that, with supply short across the industry, the average price of package substrates had risen more than it expected ³³. The materials inside the substrate are harder to replace. Mitsubishi Gas Chemical, a

⁴³ Notice Concerning the Acquisition of Japan Display Inc.'s Mobara Fab. Shinko Electric Industries · 30 September 2026 [A](https://www.shinko.co.jp/english/news/docs/20260930-01_en.pdf)

⁹ TTM TECHNOLOGIES INC, Form 10-K annual report for the period ended 2025-12-29 (10-K). U.S. Securities and Exchange Commission (filing by TTM TECHNOLOGIES INC) · 17 February 2026 [A](https://www.sec.gov/Archives/edgar/data/1116942/000119312526051976/ttmi-20251229.htm)

⁴⁴ Nittobo Group Integrated Report 2025. Nitto Boseki (Nittobo) · 16 September 2025 · p. 7 [A](https://www.nittobo.co.jp/eng/ir/pdf/Nittobo_Integrated-Report_2025.pdf#page=7)

⁴⁵ Thailand carves out a less-glamorous AI niche: printed circuit boards. Nikkei Asia · 3 September 2025 [B](https://asia.nikkei.com/business/technology/tech-asia/thailand-carves-out-a-less-glamorous-ai-niche-printed-circuit-boards)

³³ Ibiden, questions and answers from the financial presentation for the first quarter of the year ending 31 March 2027. Ibiden · 5 August 2026 [A](https://www.ibiden.com/ir/items/en_QA_FY2026Q1.pdf)

laminate maker, says chipmakers and electronic device makers further down the chain approve the materials it sells to substrate makers ¹. Ajinomoto dominates the film, and Nitto Boseki dominates the low-expansion glass cloth in the core. Both are adding capacity on plans that run for years.

Packages are also getting bigger. TSMC told investors in July 2026 that its CoWoS packaging roadmap goes beyond 14 times the area a lithography machine can print in one shot ⁴⁶. A bigger package warps more and needs more layers, so it has more holes that can break the circuit. That lowers yield, the share of substrates that come out working, and each substrate is already expensive before a chip is mounted on it.

FOUR THINGS TO REMEMBER

- A package substrate connects a chip's fine contacts to a circuit board wired in millimeters.
 - One Japanese supplier leads the market for the substrate's insulating film, and another leads the market for its glass cloth.
 - Replacing the film would mean re-approval by every substrate maker and chip customer.
 - The White House's 2021 supply chain review named no American firm among the key substrate makers. Absolics is building a glass substrate plant in Georgia, and a Commerce Department agency expects its production capacity to come online in 2027.
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Made by **Yashvardhan Sharma** with Claude. Corrections and questions: contact@chipsupplychain.org.

UPDATED 20 OCTOBER 2026

A company filings, governments, standards bodies, universities and research institutions; **B** SemiAnalysis, Reuters, the Financial Times and Nikkei Asia.

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¹ Electronics Materials Business (Mitsubishi Gas Chemical business briefing). Mitsubishi Gas Chemical · 2 October 2024 · p. 12 **A** www.mgc.co.jp/eng/ir/files/2410022e.pdf#page=12

⁴⁶ Q2 2026 Taiwan Semiconductor Manufacturing Co Ltd Earnings Call (Chinese, English) — edited transcript. LSEG StreetEvents (transcript of a TSMC earnings call), via TSMC · 16 July 2026 · p. 16 **A** investor.tsmc.com/english/encrypt/files/encrypt_file/reports/2026-08/3e494f0c14dd0890f897aa044415e21d93486cc4/TSMC%202Q26%20Transcript.pdf#page=16

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