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TRADE LENS

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LENS INSIGHT / No.03

GPU power, higher integration and the component supply chain

Why Do Substrates and MLCCs Both Matter More as AI Servers Scale Up?

How Rising GPU Power and Integration Are Reshaping
the Component Supply Chain

CONNECTION DENSITY

Chip and memory integration
FC-BGA · high-layer-count PCB

POWER DENSITY

Higher current · fast load changes
Power network · advanced MLCCs

**More computing needs tighter connections
and more stable power.**

From component roles and design constraints to Korean companies' business links and profitability. Why both matter—and why their benefits differ.

01 / RESEARCH VIEW

Substrates connect. MLCCs stabilise voltage.

They matter together not because they are similar components, but because they solve complementary constraints in the same system.

TradeLens view | A positive medium-term outlook for advanced substrates and power components

More tightly integrated GPUs need both signal connections and stable power. High-density, high-speed substrate routing and MLCC-based voltage stabilisation are complements that enable the same performance upgrade. The growth opportunity is better understood as a shift towards higher-specification products than a uniform increase in the volume of generic parts.

System change	What substrates must deliver	What MLCCs must deliver
Greater chip and I/O integration	Fine routing, layer registration and power paths	Charge delivery in limited space around the chip
Higher power and faster load changes	Power and ground designs that limit voltage drop and heat	Effective capacitance, low parasitics, and thermal and mechanical reliability
Expansion from servers to racks and networks	More advanced high-speed boards for accelerators, switches and related systems	Different component configurations at each power-conversion stage and load

Technical basis: [1] [2] [7] [8] [10]. These are industrial linkages, not fixed multiples for growth in component usage.

Demand moves together; profit pathways do not

Advanced substrates must monetise more complex processing, while MLCCs must deliver performance at actual voltage and frequency conditions. Greater importance does not mean equal profits for every manufacturer. Customer specifications, good-unit shipments and product-level costs determine business results.

Technical content per system matters beyond server units

The same number of servers may require more complex substrates and more demanding power components. Conversely, some designs may use fewer, higher-performance parts. Industry growth therefore reflects not only server units, but also the specifications and component mix adopted in each system.

The central takeaway

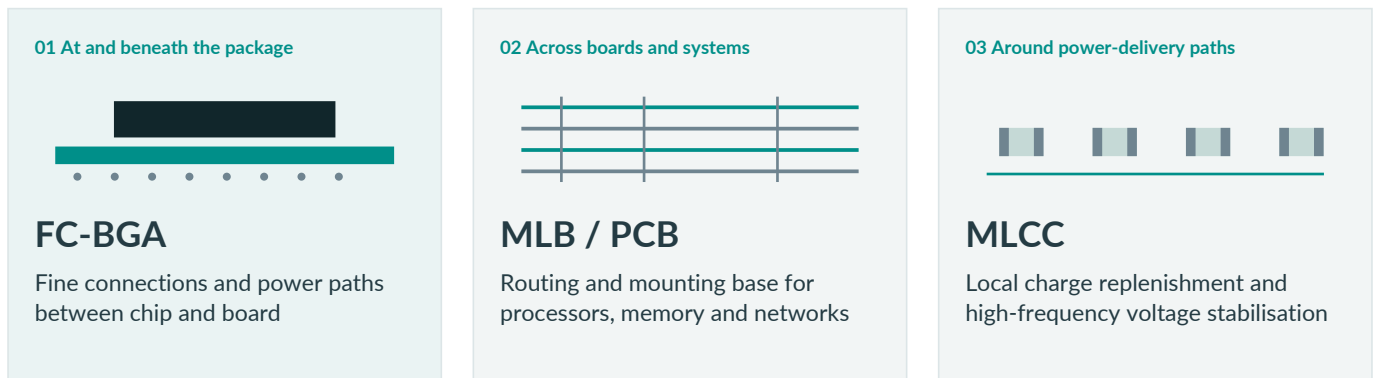
Scaling AI servers is not simply a matter of adding parts. It means handling more signals and larger currents within the same system. The technical value of substrates and MLCCs that solve these constraints rises together.

02 / SYSTEM MAP

One server, three distinct component categories

Separate the location and role of package substrates, high-layer-count PCBs and MLCCs before tracing their demand.

“Scaling up” means more than a larger enclosure: it means higher GPU integration, more data movement, greater power demand and wider connectivity. NVIDIA’s GB300 NVL72 reference connects 72 GPUs and 36 CPUs in one rack, using 18 compute trays and an intra-rack interconnect. This is one specific design, not the standard configuration of every AI server. [1]



Category	What it is	What it is not
FC-BGA	A flip-chip semiconductor package substrate	Not the entire server board or HBM itself
MLB / PCB	A board-level substrate with multiple circuit layers	Not the same source of added supply as package-substrate expansion
MLCC	A multilayer ceramic capacitor: a passive component	Not a substrate or a device that generates continuous power

Product definitions and business scope: [2] [4] [5] [8]. These are separate categories, not products made in the same manufacturing process.

Power delivery also has several stages. A power supply unit (PSU), an intermediate bus converter (IBC) and a voltage regulator module (VRM) convert power to the chip’s operating voltage. MLCCs in the power supply and those close to the chip should not be assumed to have the same ratings or uses. [7]

The link | Design the quality of power reaching the chip

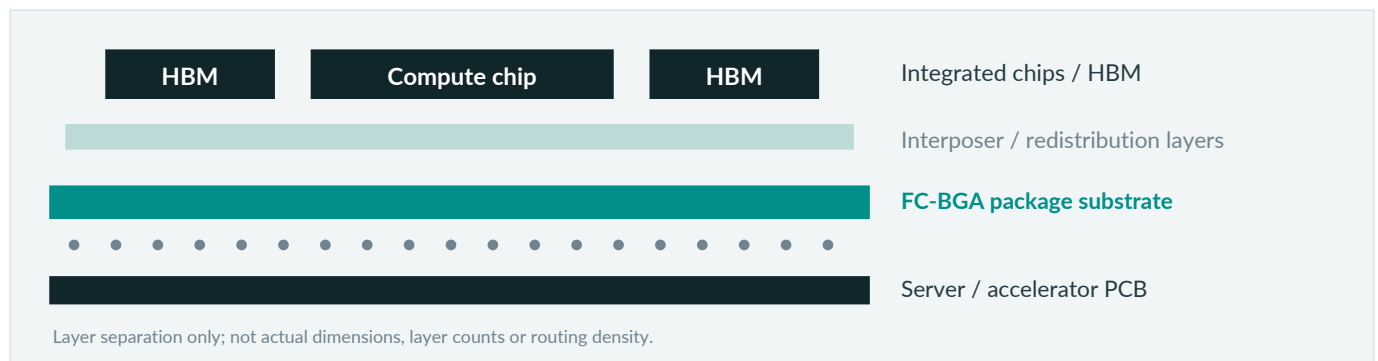
Substrates provide power and ground paths as well as signal routes. MLCCs reduce voltage fluctuations at specific points on those paths. Understanding why both matter requires looking at advanced signal routing and power-network co-design together. [10]

03 / PACKAGE SUBSTRATES

More chips make the connection layer harder

FC-BGA evolves from a physical support into a high-density connection between integrated chips and the wider system.

TSMC's CoWoS provides a route for integrating logic chips and HBM on an interposer. [14] Samsung Electro-Mechanics highlights large area, high layer counts and precise registration in HPC FC-BGA. Daeduck Electronics also presents FC-BGA for data-center processors, alongside multilayer build-up and fine-circuit technologies. [2] [3]



Integration change	Harder design / manufacturing task	Industrial significance
More fine-pitch connections and traces	Trace width, spacing and interlayer alignment	Generic processes cannot readily substitute for high-density connections
Larger packages and more stacked layers	Warpage, registration, defects and process yield	Good units available for shipment matter more than nominal processed area
Signals, power and ground needed together	Allocation of limited layers and space	Power quality requires a design solution of its own

The diagram separates the layers of an integrated package using an interposer or related structures. Not every product has this architecture. FC-BGA and an interposer are not the same component. [2] [14]

Chip counts and substrate counts are not one-to-one. Combining multiple chips in one package can increase substrate area and routing complexity without increasing substrate units at the same rate. Shipment counts and technical content per package must be assessed separately.

Assessment | More valuable chips make reliable connections more valuable

High-performance chips can fulfil their potential only if the final package provides stable connections. Higher substrate specifications can support pricing, but also raise process difficulty. Industrial opportunities are likely to concentrate among suppliers that turn this complexity into good units and reliable delivery.

04 / HIGH-LAYER PCB

Beyond the chip, the challenge shifts to the PCB

Dense connections inside packages and fast connections between systems are solved through different manufacturing processes.

AI computation does not end at a single processor. Accelerator boards and network equipment must exchange data. Isu Petasys lists PCBs for AI accelerators separately from multilayer boards for routers, switches and backplanes. Both can be exposed to AI investment, but FC-BGA and MLB differ in customers, design and manufacturing. [4] [5]

Board-level challenge	Required technology / design	Why more layers alone are insufficient
Faster signal transmission	Loss control across traces, materials, connectors and vias	Discontinuities and losses still impair signal quality
More components and connections	Space allocation for interlayer routing, power and ground	Signal layers must be combined appropriately with power and ground layers
Thicker boards	High-aspect-ratio processing, plating, registration and reliability	Drilling and interlayer connections require precision
Links to high-speed optical modules	Surrounding PCB and electrical interfaces	More optical communications do not eliminate all electrical traces on the board

Daeduck's MLB materials describe backdrilling to reduce unwanted via stubs in high-speed signal paths, precision drilling and build-up structures for optical modules. Layer count is therefore only part of the question; actual signal quality and reliability matter too. [6]

More signal routing still needs space for power and ground

Board area is finite, yet signal routing, power paths and component mounting space are all required. Optimising fast connections and high-current delivery separately can run into space and return-path constraints on the actual board. High-layer-count design and capacitor placement thus share a system-resource allocation problem. [10]

This is also why layer-count growth alone cannot quantify the benefit of PCB upgrades. Adding layers and satisfying signal quality, power stability and reliability within that structure are different challenges.

Shared PCB theme, different business exposure

AI accelerator boards, server boards and switch or network boards have different order pathways. Capacity expansion or customer adoption in one application should not be treated as revenue growth in another. The unit of analysis is the end-use product and process capability—not simply “a PCB company”.

NVIDIA's reference also includes intra-rack copper connections and separate networking. It does not imply that all GPU-to-GPU signals pass through a single motherboard. [1]



05 / POWER DELIVERY

1.67× the power; 2.78× the path loss

Illustrative calculation | Delivering more power at low voltage makes even small substrate-path resistance important.

Server power reaches CPUs and GPUs through stages such as the PSU, intermediate bus and voltage regulation. A higher bus voltage can help upstream distribution, but does not remove the low-voltage, high-current path near the chip. TDK highlights rising demands on loss, ripple, heat and density management at each stage. [7]

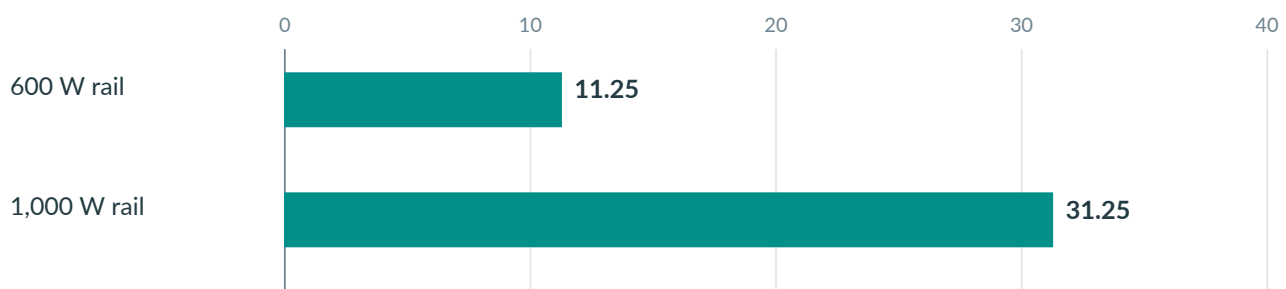
Illustrative assumptions | One low-voltage rail: 0.8 V and 0.02 mΩ path resistance

Compare 600 W and 1,000 W delivered to the chip load. Current $I = P \div V$; voltage drop $= I \times R$; resistive path loss $= I^2 \times R$. Voltage and resistance are held constant. These are not the actual power specifications of a particular GPU.

Assumed load power	Current	Path voltage drop	Resistive path loss
600 W	750 A	15 mV	11.25 W
1,000 W	1,250 A	25 mV	31.25 W

Resistive path loss

W · Illustrative assumptions



Analysis | Substrates must also deliver power with low loss

With a 1.67-fold increase in load power, loss through the same resistance rises about 2.78-fold. This increases the importance of shorter paths, power and ground placement, conductor design and vias. MLCCs do not eliminate a sustained $I \times R$ voltage drop. The substrate's power path and transient charge replenishment require separate design treatment.

$R = 0.00002 \Omega$. This simple model maintains load voltage and excludes efficiency, resistance changes with temperature, multiple rails and voltage-regulator losses. Do not compare it directly with rack power or use it as an estimate of actual server energy savings.



06 / MLCC & TRANSIENTS

Available charge matters more than part count

MLCCs bridge brief current shortfalls close to the power network, but nominal capacitance alone does not explain their performance.

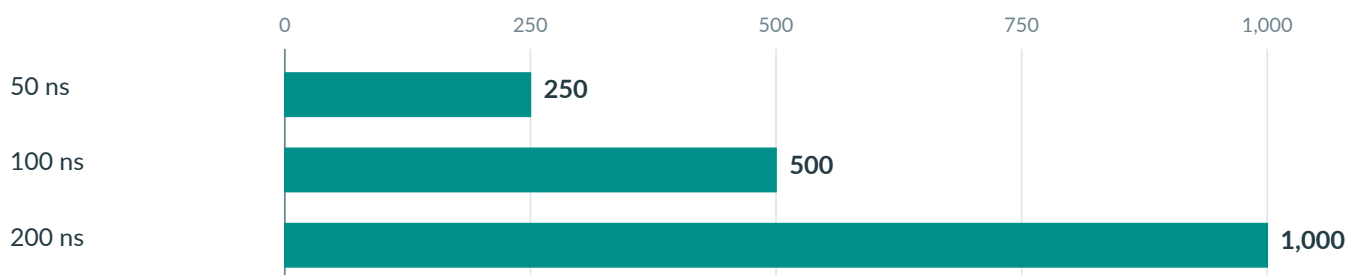
A rapidly changing compute load can create intervals in which the power supply cannot respond immediately. MLCCs temporarily release and absorb charge to reduce voltage fluctuations. Their actual role depends not only on capacitance but also on equivalent series resistance (ESR), equivalent series inductance (ESL), operating frequency and mounting position. [8]

Illustrative assumptions | 100 A current shortfall; 20 mV allowable voltage change

If ideal capacitors alone cover the shortfall, required effective capacitance is $C = \Delta I \times \Delta t \div \Delta V$. A 100 ns interval corresponds to 500 μF . These values illustrate the principle; they are not a component-selection specification for an actual GPU.

Required effective capacitance

μF · Illustrative assumptions



Beyond nominal capacitance

What changes in a real design

Does capacitance stay the same under voltage?

For Class 2 MLCCs, effective capacitance can change with DC bias and temperature. [9]

Is a larger part count the only answer?

Low-ESL products and better placement may meet the target impedance with fewer components. [8] [10]

Assessment | The shift is towards higher-specification product mix

Higher integration may require more capacitance, or fewer high-performance parts in the same space. The core MLCC growth driver is not a universal increase in units, but useful performance under actual voltage, frequency and space constraints.

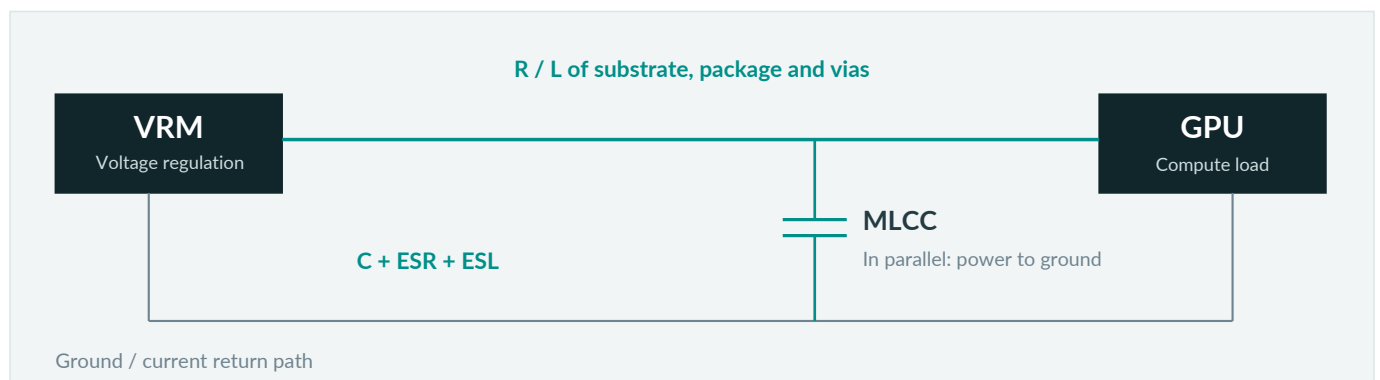
The charge model excludes ESR, ESL, routing, resonance, voltage-regulator response and the contribution of other capacitors. Do not convert the plotted capacitance into a specific MLCC count. The older Murata material is used only to explain physical characteristics.

07 / CO-DESIGN

Poor board layout can undermine a good MLCC

Power integrity is the result of the substrate, package and capacitors as a network—not the performance of a single component.

Substrate conductors and vias also have resistance and parasitic inductance. TDK's power-integrity (PI) materials describe selecting MLCC type, count and placement using board information as well. This is the most direct reason to analyse substrates and MLCCs together. [\[10\]](#)



Dominant issue	Substrate / package role	MLCC role
Delivery of average current	Manage path resistance, heat and the allocation of power and ground	Does not generate continuous power
Fast current changes	Minimise path and return-loop inductance	Deliver and absorb charge through a short connection
Voltage fluctuations across frequencies	Design impedance including traces and components	Respond through the combination of effective capacitance, ESR and ESL

The diagram separates roles in the power network; it is not a product circuit or a placement instruction. The MLCC is not shown in series with a signal-transmission line.

Enough charge must still arrive at the right moment

Inductive voltage change is proportional to $L \times di/dt$. Fast current changes therefore require not only low capacitor ESL but also a short connection path. Buying a good component is not enough: board routing and placement must be considered with it.

How growth evolves | Both matter, while the component mix keeps changing

Samsung Electro-Mechanics also presents thin, low-ESL silicon capacitors. [\[11\]](#) As more alternatives improve performance at specific locations, substrate-capacitor co-design becomes more important. This implies neither the disappearance of MLCCs as a whole nor a uniform increase in their unit count.

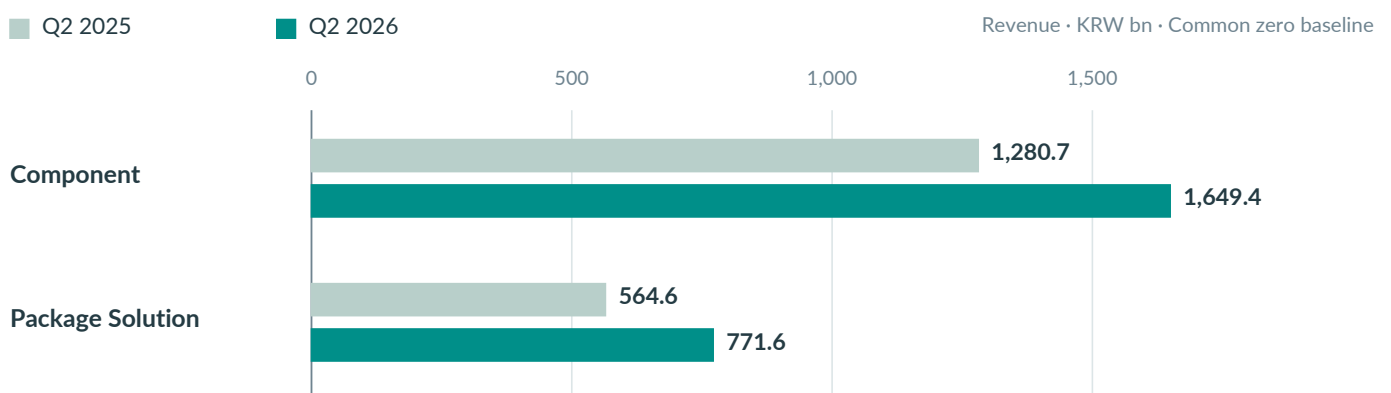


08 / COMMERCIAL EVIDENCE

Higher specifications already show up in revenue

Samsung Electro-Mechanics' Q2 2026 results link technical requirements to actual business activity.

In its 30 July earnings release, Samsung Electro-Mechanics attributed improvement to higher MLCC supply for data centers and automotive applications, and higher-value substrates for AI accelerators and server CPUs. The growing importance of both component groups is therefore not merely conceptual. However, total segment revenue is not AI-only revenue. [12]



Segment	Year-on-year revenue increase	Company explanation
Component	KRW 368.7 bn / +28.8%	Higher MLCC sales for data centers, automotive and other uses
Package Solution	KRW 207.0 bn / +36.7%	More substrates for AI accelerators, server CPUs and automotive uses

Source: Samsung Electro-Mechanics Q2 2026 IR. Same-quarter, same-segment comparison. Revenue includes non-AI applications and does not represent individual product margins. Amounts are shown in KRW bn; no currency conversion is applied. [13]

Revenue evidence differs from a promise of future supply

The MLCC long-term supply agreements discussed in the same release indicate that customer demand is translating into actions to secure supply. Contracts alone do not establish incremental revenue or profit. The point here is not contract size, but the fact that higher-specification products have begun to enter customers' actual systems and orders. [12]

Analysis | Technical upgrades are changing the product mix

The medium-term outlook is positive. The next proof must come from sustained high-value product shipments and manufacturing profitability, not more announcements. Both revenue streams are expanding, but that does not establish an industry-wide shortage or equal margins for all suppliers.

09 / KOREAN VALUE CHAIN

Three distinct routes through Korea's supply chain

Connect companies to actual products and applications—not simply to the words “substrate” or “capacitor”.

Company / stock code	Business connection in official materials	Conditions for higher specifications to become profit
Samsung Electro-Mechanics 009150	Offers FC-BGA and MLCCs; reports higher sales of high-value AI/server substrates and data-center MLCCs. [2] [8] [12]	Higher-value mix, good-unit shipments and stable costs in both businesses. Common ownership alone does not establish integrated design or a margin advantage.
Daeduck Electronics 353200	FC-BGA products and substrates for data-center processors, with MLB technology presented separately. [3] [6]	Customer adoption, shipments and yield for high-layer-count, fine-circuit products. Distinguish actual CPU, GPU and ASIC customer and product mix.
Isu Petasys 007660	AI-accelerator PCBs and high-layer-count MLBs for network equipment. [4] [5]	Accelerator and switch product mix, and good-unit output from new lines. Separate this from package substrates and MLCCs.

Companies are ordered by product scope, not as stock recommendations. No shared customer, joint delivery or contract for a specific GPU is assumed.

Dual exposure at Samsung; process-specific strengths elsewhere

Samsung Electro-Mechanics lets readers observe both axes within one company. Daeduck can be analysed through advanced package substrates, while Isu Petasys offers exposure to accelerator and network-board upgrades. Owning a product range is a starting point; customer-accepted specifications and earnings contribution are separate stages.

The same design transition requires different units of analysis

Analytical axis	What to connect to business results
Package substrates	Adoption and volume shipments of advanced products for customer processors
Accelerator / network PCBs	Board- and equipment-level volume, and high-layer-count product mix
MLCCs	Specification transitions and component value adopted by power application and product

The next step beyond business exposure

Ask which component is used where, whether customer approval and shipments exist, and whether profit remains after additional costs. Assess each company's customer mix and AI revenue share only within its own disclosures. This separates real product participation from thematic association.

10 / PROFIT TRANSLATION

Technical importance is not supplier profit

A positive industry view still requires tracing where the economic gains from higher specifications are consumed.

An analytical bridge from systems to component revenue

Component revenue can be viewed as systems available for shipment × component value adopted per system × the supplier's share. Substrate area, layer count and complexity—and MLCC specifications, mix and quantity—change that value. This is an analytical framework, not an estimate of customer-specific volumes.

Growth pathway	Economic opportunity	Why the benefit is not automatic profit
Larger, higher-layer-count substrates	Higher pricing and component value for more complex products	More processing time, materials, defects, rework and depreciation
High-capacitance, low-ESL, high-reliability MLCCs	A product mix that solves constraints and deepens customer relationships	Fewer high-performance parts per design, competitive pricing and manufacturing costs
Customer approval and repeat design wins	Repeat orders supported by design continuity and delivery reliability	Design changes, multiple sourcing, warranty costs and customer concentration
New facilities and expanded supply	Capacity to serve growth volumes	Ramp-up yield, upfront investment, inventory and receivables

Start with shipment mix; finish with cash

Higher substrate pricing may not protect profit if good-unit yield falls. MLCC opportunities can remain even when unit sales decline, if advanced products simplify a customer's design. Product mix, unit profit and utilisation should be assessed alongside volume and pricing.

Cash flow also bears the cost of capacity expansion and working capital. If revenue growth becomes tied up in inventory and receivables, cash conversion is delayed. Industry demand provides a favourable setting; how much value is retained depends on company execution.

Assessment | Emphasise profitable specification upgrades, not unit growth alone

The shared opportunity is the shift in component requirements created by more advanced GPUs. Companies that raise component value per design while managing yield, costs and investment recovery are more likely to turn that transition into sustained earnings.

11 / OUTLOOK & FALSIFICATION

Both matter more. They do not grow at equal rates.

Connect the question of why both are important to the evidence that will determine future business performance.

Overall view | Connection density and power density are rising together

We are positive on the medium-term business opportunities in FC-BGA, high-layer-count PCBs and advanced MLCCs. Chips exchanging more data need precise connections; chips using large currents at low voltage need stable power networks. Substrates and MLCCs jointly fulfil these requirements.

Area	Evidence that strengthens the view	Evidence that weakens the view
Package and board upgrades	Repeat adoption and more good-unit shipments of advanced products	Delayed design approvals, stagnant yield or lower customer volumes
Power-component specification shifts	Better performance at actual voltage/frequency conditions and an improved mix	Alternative architectures or part-count reductions sharply reduce component value per system
Supplier profitability	Revenue and unit profit improve together; operations stabilise	Defects, warranty costs and fixed costs rise faster than pricing
Durability of demand	Follow-on customer platforms and repeat orders	Capacity growth outpaces demand or customers delay investment

What to check in the next results

First, look for actual growth in high-value AI/server product shipments. Second, test whether those shipments generate profit after manufacturing cost and yield effects. Third, check that cash recovery follows after investment and working-capital needs. Distinguish targeted specifications and capacity plans from completed results.

The answer for readers

GPUs alone do not complete AI-server performance. Substrates connect more signals and carry more current, while MLCCs damp transient fluctuations in that power network. Both component groups become more important, but the size of the benefit depends on specifications, adoption and volume-production economics.

The falsification criteria above are tests of the outlook, not statements that these problems have occurred. This report analyses businesses and industries; it does not provide buy/sell opinions, trading timing, fair-value estimates or price targets.

12 / SOURCE REGISTER

Follow the evidence to its source

Click a teal citation number, source title or “Open source” to open the original material.

01. NVIDIA | NVL72 AI Factory — System Hardware & Components

As of 30 Sep 2026 · Public reference · GB300 NVL72 configuration and interconnects · [Open source](#)

02. Samsung Electro-Mechanics | FCBGA — High-density package substrates

As of 30 Sep 2026 · Product/technical material (Korean) · Fine routing, layers and area · [Open source](#)

03. Daeduck Electronics | PKG — FC-BGA products and core technologies

As of 30 Sep 2026 · Product/technical material (Korean) · Data-center processor substrates · [Open source](#)

04. Isu Petasys | PCBs for AI accelerators

As of 30 Sep 2026 · Official product page (Korean) · AI accelerators and OAM modules · [Open source](#)

05. Isu Petasys | PCBs for network equipment

As of 30 Sep 2026 · Official product page (Korean) · Router, switch and backplane MLBs · [Open source](#)

06. Daeduck Electronics | MLB — Wired Network / Optical Module

As of 30 Sep 2026 · Technical material (Korean) · Backdrilling, high-speed and optical PCBs · [Open source](#)

07. TDK | MLCC Solutions for Data Center (AI Server) Power Systems

Jul 2026 · PSU, IBC and VRM power paths and changing component requirements · [Open source](#)

08. Samsung Electro-Mechanics | MLCC — Product portfolio and technical FAQ

As of 30 Sep 2026 · Technical material (Korean) · ESR, ESL, DC voltage and mounting · [Open source](#)

09. Murata | Evolving Capacitors, Part 2: Technology (part 2/2)

22 Sep 2014 · Used only for the principles of DC bias and temperature characteristics · [Open source](#)

10. TDK | Technical Support Using PI Simulation

As of 30 Sep 2026 · Technical material · Board parasitics and low-ESL capacitor co-design · [Open source](#)

11. Samsung Electro-Mechanics | Silicon Capacitor

As of 30 Sep 2026 · Official product page (Korean) · Thin, low-ESL capacitor applications · [Open source](#)

12. Samsung Electro-Mechanics | Q2 2026 earnings results

30 Jul 2026 · Earnings release (Korean) · MLCC/FC-BGA growth drivers and company outlook · [Open source](#)

13. Samsung Electro-Mechanics | Q2 2026 earnings presentation

30 Jul 2026 · PDF pp. 4, 6–7 (Korean) · Consolidated/segment revenue and business context · [Open source](#)

14. TSMC | CoWoS — Advanced integration platform

As of 30 Sep 2026 · Official technology material · Logic/HBM, interposer and substrate layers · [Open source](#)

Source scope: Undated product and technical pages reflect public descriptions at the analysis date. Older technical materials explain physical principles; 2026 earnings materials establish business links for that quarter. Company outlooks and product descriptions are distinct from realised results. No company-level AI revenue share or customer supply relationship has been estimated.

13 / METHODOLOGY & USE

Basis, disclaimer and permitted use

Distinguish sourced facts, company outlooks, TradeLens assessments and illustrative calculations.

Item	Basis applied
Analysis date	30 September 2026. Product/system materials and official Q2 2026 results, with each source's date and scope kept distinct.
Scope	FC-BGA package substrates, board-level PCB/MLB and MLCCs for power delivery; distinguished from interposers and silicon capacitors.
Financial scope	Same-quarter revenue for Samsung Electro-Mechanics' Component and Package Solution segments—not AI-only revenue or individual product margins.
Illustrative models	Page 6: power, current and resistance. Page 7: current shortfall, duration and capacitance. These are not actual GPU designs, component counts or company forecasts.
Service scope	Industry and business analysis. No buy/sell opinions, trading timing, fair-value estimates, price targets or individual investment advice.

Units: 1 mΩ = 0.001 Ω; 1 ns = 0.000000001 seconds; 1 μF = 0.000001 F. Results are rounded for display. KRW revenue figures are shown in billions, with 1 Korean eok won equal to KRW 0.1 bn; no exchange-rate conversion is used. Electrical models hold selected variables constant and are not system-optimisation results. TradeLens has redrawn the diagrams and charts; they do not imply source-institution approval or endorsement.

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