GLOBAL X INSIGHTS

The Case for MLCCs: An Emerging AI Bottleneck

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Date: September 11, 2026
Topic: Artificial Intelligence

AI's power-supply challenge extends from the grid to the chip. While much of the focus has been on securing enough electricity for data centers, that power must also be managed as it moves through increasingly dense, power-hungry AI hardware. This is elevating the role of a lesser-known component: the multilayer ceramic capacitor, or MLCC. Built from ultra-thin layers of ceramic and metal electrodes, MLCCs rapidly store and release charge, helping stabilize voltage, filter electrical noise, and keep sensitive circuitry operating reliably.

AI servers can use more than ten times as many MLCCs as general-purpose servers.[1] They also require smaller, higher-capacitance products able to withstand greater electrical and thermal stress. Rising volumes and technical complexity are shifting demand toward higher-value, higher-specification products. MLCC demand tied to AI servers could rise 4.3x between 2025 and 2030.[2] Yet global supply is concentrated among a handful of manufacturers in Japan, South Korea, and Taiwan, with capacity able to grow only 10 to 15% annually.[3]

Against this backdrop, manufacturers with the technical expertise and production capacity to meet AI's increasingly demanding requirements are gaining strategic importance and pricing power. To help investors capture this opportunity, we are introducing the **Global X MLCC & Electronic Components ETF** (ticker MLCC), which provides targeted exposure to the leading global suppliers of MLCCs and related electronic components through a single U.S.-listed ticker.

Key Takeaways

- AI is increasing both MLCC volumes and technical requirements, driving demand for components capable of operating under greater electrical, thermal, and space constraints.
- More than 85% of global MLCC supply is controlled by five manufacturers based in Japan, South Korea, and Taiwan, positioning a narrow group of suppliers at an increasingly important point in the AI hardware value chain.[4]
- The Global X MLCC & Electronic Components ETF (ticker MLCC) provides targeted exposure to leading global suppliers of MLCCs and related passive electronic components, concentrating towards the largest suppliers.

MLCCs, Explained

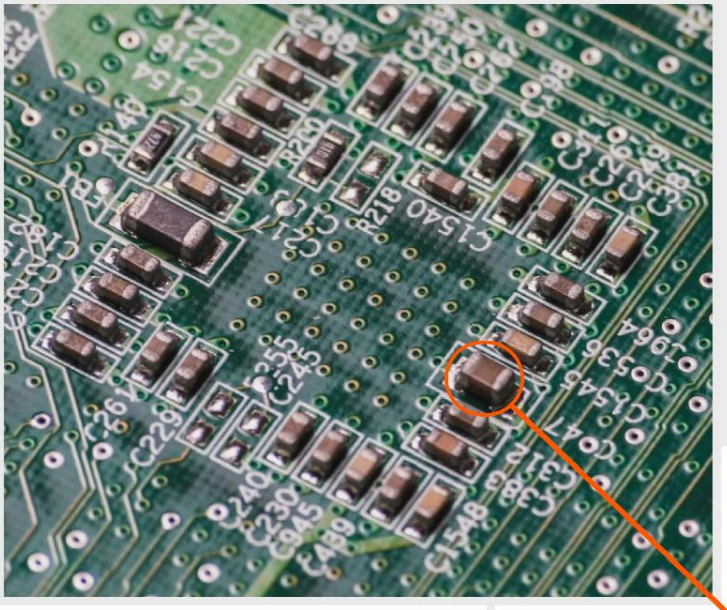
Every modern electronic circuit faces the same basic challenge: power demand can change faster than the system supplying it can respond. A processor shifting workloads, memory accessing data, or a sensor turning on can create sudden swings in current, causing voltage to dip or spike and introducing electrical noise. MLCCs help smooth those fluctuations.

Placed throughout a circuit, typically close to the components they support, MLCCs act as tiny local reservoirs of electrical charge. They release charge almost instantly when demand rises and absorb it when demand falls, helping stabilize voltage. They also filter high-frequency noise, allowing processors, memory, and other components to receive the clean, reliable power they need to operate properly.

Because they are ubiquitous across modern electronics, MLCCs are sometimes described as the "rice of electronics." A premium smartphone can contain more than 1,000, while an electric vehicle with advanced autonomous capabilities can use as many as 30,000.[5,6] As electronic systems become more power-dense and complex, both the number and value of MLCCs tend to rise.

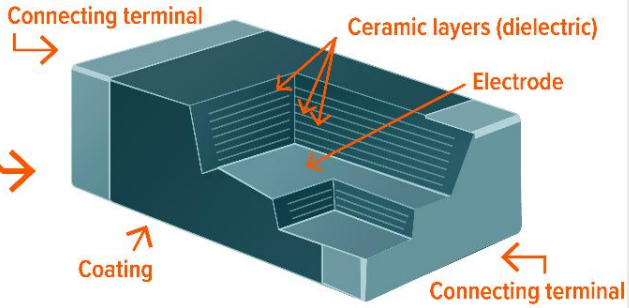
Historically, consumer electronics drove much of industry demand, exposing suppliers to sharp inventory cycles when smartphone, PC, or television demand slowed. AI servers, electric vehicles, and industrial automation are now broadening the demand base while shifting the product mix toward higher-value components.

MLCC, VISUALIZED



Capacitors store electrical energy by holding opposing charges on two conductive electrodes separated by an insulating material. An MLCC repeats this basic structure across dozens to more than 1,000 ultra-thin layers of ceramic and metal electrodes inside a tiny package.

Stacking these layers increases the component's charge-storage capacity without significantly increasing its footprint, making MLCCs especially useful in compact, densely packed electronic systems.



Source: Global X ETFs. Image Credit: LHS: EuroTronix. (2025, July 8). Practices and solutions to prevent MLCC fracture damage. RHS: EPCI. (2026, May 14). MLCC and Ceramic Capacitors.

AI Infrastructure Drives a Step-Change in MLCC Demand

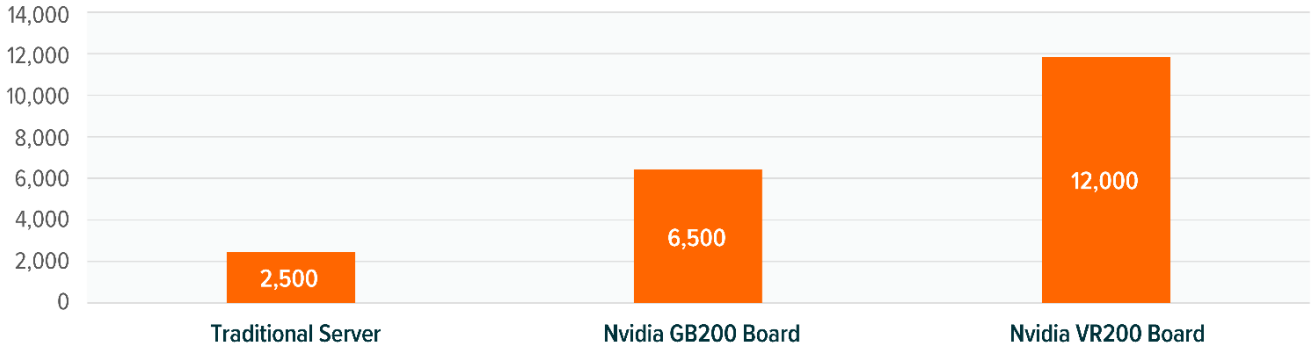
Power density is becoming a central constraint in AI infrastructure. A single modern AI rack (Nvidia GB300 NVL72) can use roughly 142 kilowatts of power, nearly 16 times as much as a conventional server rack.[7] These racks also experience large, rapid swings in current demand, placing greater pressure on voltage regulation and power delivery across the entire system, from chips to cooling and beyond.

For example, a standard Nvidia Grace Blackwell 200 (GB200) chip board can shift from near-idle to full-power loads thousands of times per second. Each transition creates a near-instantaneous surge in the current required by its processors – far faster than the primary power supply can respond. System designers therefore place dense arrays of MLCCs around each AI chip. These capacitors act as local energy reservoirs, releasing charge during the brief interval between the chip's demand and the power supply's response.

These requirements are driving a step-change in the number of MLCCs used in the latest AI servers. Samsung Electro-Mechanics estimates that individual AI server boards can contain ten times as many MLCCs as a traditional server.[8] A single Nvidia GB200 compute board uses approximately 6,500 MLCCs, and the next-generation Rubin architecture could push that to around 12,000 MLCCs.[9] Across the compute, networking, storage, cooling, and power-delivery boards housed within a full rack-scale system, an Nvidia GB200 NVL72 rack can contain 300,000 to 400,000 MLCCs. The count could go as high as 600,000 MLCCs on upcoming Vera Rubin racks.[10,11]

MLCC CONTENT IN AI SERVERS EXPECTED TO NEARLY DOUBLE FROM BLACKWELL (GB200) TO RUBIN (VR200) ARCHITECTURE

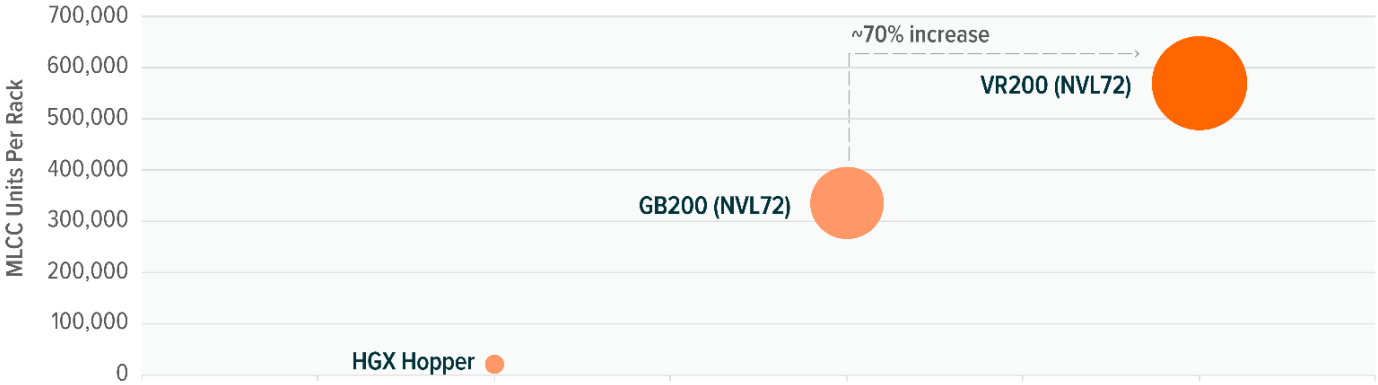
Estimated MLCC Count per Compute Board



Source: Aetrix. (2026, May 29). AI Server MLCC Shortages: Capacity Reallocation and High-Capacitance Pressure.

BEYOND COMPUTE: RACK-SCALE AI SYSTEMS ADD UP TO SUBSTANTIALLY MORE MLCC CONTENT

Estimated MLCC Count per Rack-Scale System



Note: Rack scale systems includes MLCCs used for servers, storage, power, networking, and broader components of a full AI rack.
Source: Morgan Stanley Research. (2026, June 22). MLCC Super Cycle – The Other AI Squeeze; TrendForce. (2026, May 18). MLCC Prices Are Expected to Rebound Due to Rising Demand from High-End Applications and Increased Channel Stocking Activities for Consumer-Grade Components.

AI systems also require smaller capacitors with higher capacitance, greater voltage tolerance, and stronger performance under thermal and mechanical stress. Because some capacitors must sit close to processors while board space becomes scarcer, manufacturers must store more charge in smaller footprints, which adds another layer of complexity in system design. Some AI-server MLCCs must also support operating temperatures of at least 105 degrees Celsius while these chips are running at full throttle. These constraints are leading chipmakers towards components that are more difficult to manufacture and typically command higher prices.

Lastly, while the demand cycle for the next few years may be server-led, AI consumer devices and other edge-computing hardware could further amplify the demand for MLCCs and passive electronics beyond the current backdrop. Rising power density is also increasing requirements for adjacent passive electronic components, including inductors, resistors, transformers, thermistors, and circuit-protection devices used across voltage conversion, filtering, networking, and power supplies.

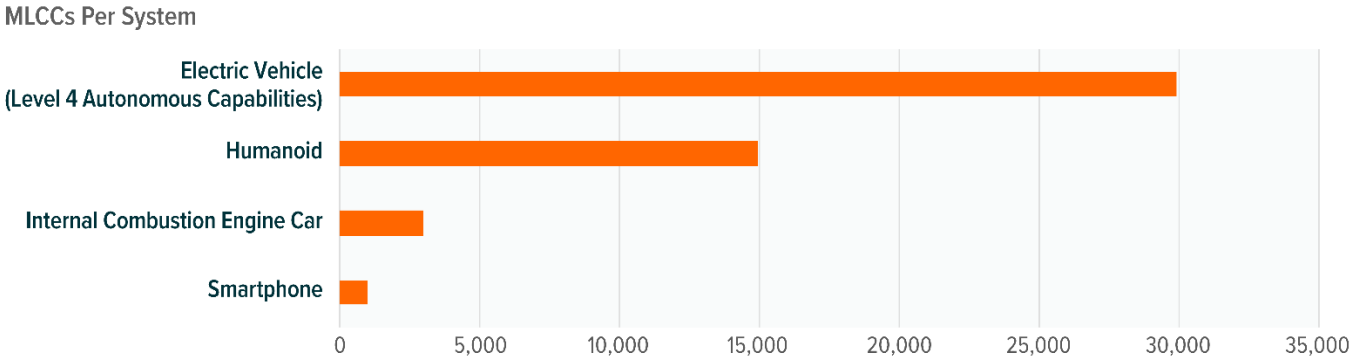
Electrification Adds Second Demand Engine

AI is arriving alongside a broader shift toward electrification. A single electric vehicle can contain roughly 20,000–30,000 MLCCs across its powertrain, battery-management system, sensors, cameras, and electronic control units.[12] Automotive MLCCs also face significantly higher reliability requirements.[13] Development cycles can take roughly three times longer and components can command more than

three times the price of comparable IT components.[14] Once an MLCC has passed qualification and been designed into a vehicle platform, replacing it may require additional engineering work and customer approval, making supply relationships relatively sticky.

Robotics, industrial automation, and power infrastructure further broaden this demand, which scales with increasing power density.[15] Notably, together these applications are diversifying MLCC demand away from consumer electronics and toward markets where qualification and materials expertise create higher barriers to entry.

MLCCS ARE ESSENTIAL ACROSS MODERN ELECTRONICS, INCLUDING PHYSICAL AI SYSTEMS

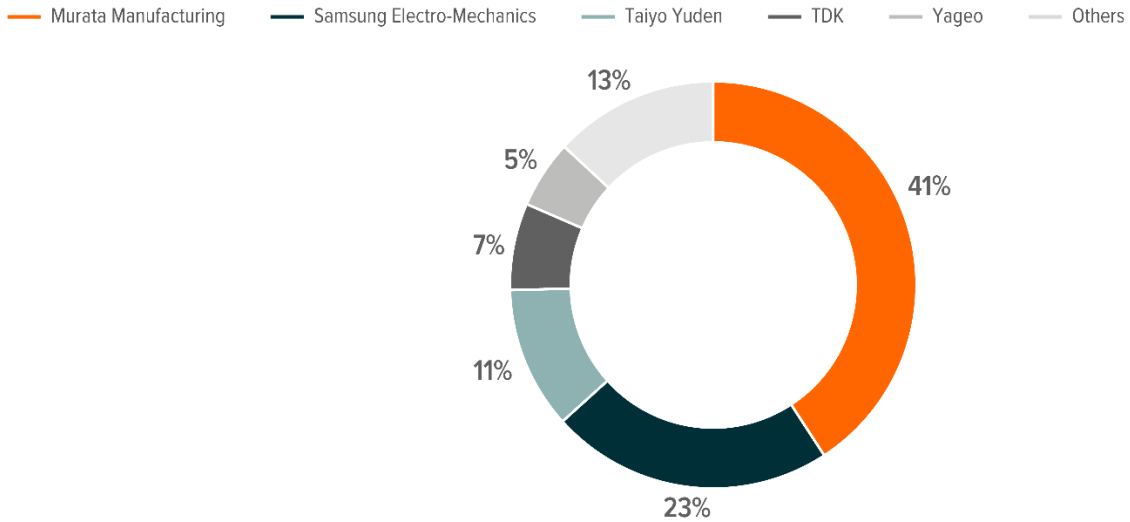


Source: Global X ETF estimates, as of August 28, 2026, based on information from: Murata. (2021, May 3). Installing Electronic Circuits of Dramatically Increasing Size into Compact Devices - Murata's MLCC for 5G Smartphones, Samsung Electro-Mechanics. (2025, July 21). Samsung Electro-Mechanics Bets Big on MLCC for AI Servers and Automotive Electronics — Reshaping its Business Around High-Growth Sectors, Samsung Electro-Mechanics. (2026, April 15). Robot Strategy as The Next AI Infrastructure: MLCC Optimization Focused on the Three Core Units—Computing, Motor Control, and Sensors.

Advanced MLCC Supply Is Highly Concentrated

More than 85% of global MLCC supply is controlled by five companies: Murata, Samsung Electro-Mechanics, Taiyo Yuden, Yageo, and TDK.[16] Their position reflects manufacturing scale and decades of expertise in ceramic formulations, miniaturization, electrode design, process control, and high-volume production.

FIVE SUPPLIERS CONTROL MORE THAN 85% OF THE GLOBAL MLCC MARKET



Source: Morgan Stanley. (2026, June 22). MLCC Super Cycle – The Other AI Squeeze. Data as of end of calendar year 2025.

The underlying manufacturing process further reinforces the concentration. A single MLCC can contain 500–1,000 alternating layers of ceramic dielectric and metal electrodes. Manufacturers print and stack these ultra-thin layers, fire them at temperatures above 1,000 degrees Celsius, and inspect the finished components for microscopic cracks or inconsistencies. Performance depends heavily on materials, component design, and proprietary manufacturing approaches. As MLCCs become smaller and denser, manufacturing tolerances narrow, and production yields become harder to maintain. The materials and process expertise required create significant barriers to entry, particularly in high-capacitance and high-reliability applications.

While MLCCs tied to everyday consumer electronics remain readily available, supply is tightening for the high-capacitance, high-voltage, and high-reliability products used in AI servers, vehicles, and industrial power systems. Lead times for certain high-capacitance AI-oriented MLCCs have extended from roughly eight weeks to as long as 20 weeks.[17] Book-to-bill ratios for three leading Japanese and Korean suppliers, Murata, Samsung Electro-Mechanics, and Taiyo Yuden, have risen to their highest levels since the pandemic.[18]

The result is what analysts describe as a K-shaped market: high-end AI and automotive MLCC supply remains tight and expensive, while many commodity-grade MLCCs remain closer to balance. Meanwhile, suppliers are reallocating capacity toward AI-grade products, reducing supply flexibility for commodity components, spreading tightness across parts of the broader market.

MLCC BOTTLENECK EXPECTED TO INTENSIFY IN 2027 AND BEYOND

Bottleneck Scale

EMERGING TIGHT HIGH

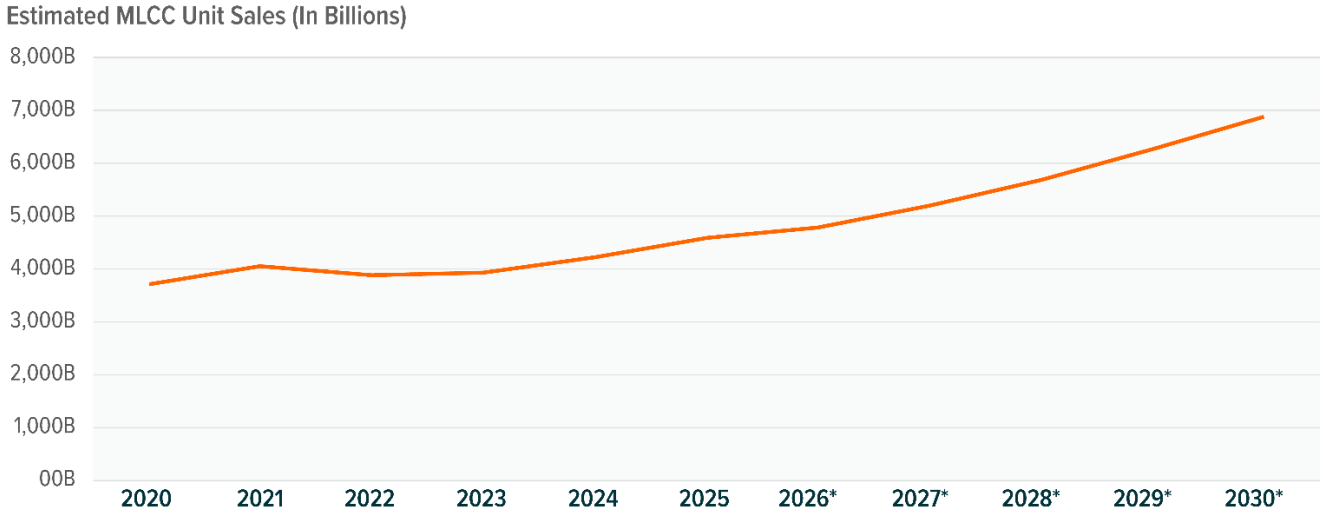
Segment	2026	2027*	2028*	Example Companies
High Bandwidth Memory				SK Hynix, Samsung Electronics, Micron
Memory Substrates				Ibiden, Shinko Electric, Simmtech
Interconnect (Co-Packaged Optics)				Broadcom, NVIDIA, Marvell
MLCC				Murata, Samsung Electro-Mechanics, Taiyo Yuden
800V DC Power Supply Unit				Delta Electronics, Vertiv, Lite-On
High-Voltage Power Semiconductors (SiC, GaN)				Infineon, STMicroelectronics, On Semi

* Forecast

Source: Global X ETFs, with information derived from: Mirae Asset Securities. (2026, June 11). 2H Outlook Report, Electrical/Electronic Components: The Next AI Bottlenecks Are Emerging. This exhibit shows bottleneck status across select AI hardware categories. Refer to the report for comprehensive coverage of bottlenecks in the AI value chain.

Pricing power has followed. Samsung Electro-Mechanics and Murata have raised prices on both AI-grade and consumer MLCCs.[19] AI server demand is also reviving long-term supply agreements as shortages intensify.[20] Samsung has signed long-term supply agreements with more than 10 global customers, including its largest-ever annual AI-MLCC supply contract worth $780 million.[21]

ANNUAL GLOBAL MLCC UNIT SALES EXPECTED TO RISE NEARLY 50% BETWEEN 2025 AND 2030, LED BY STRUCTURAL DEMAND DRIVERS

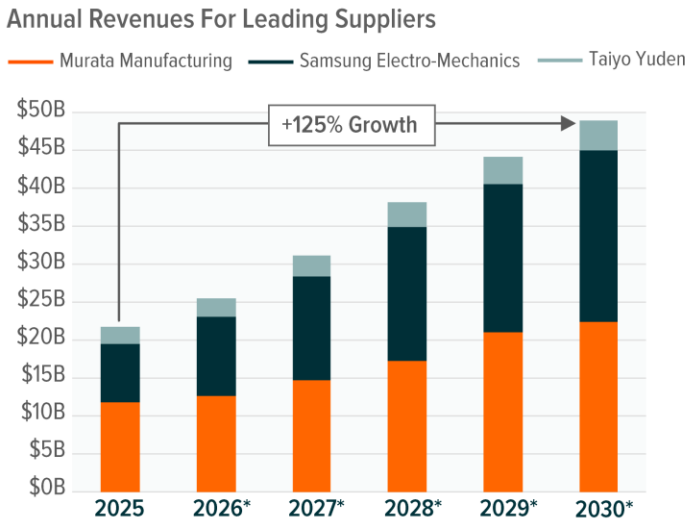


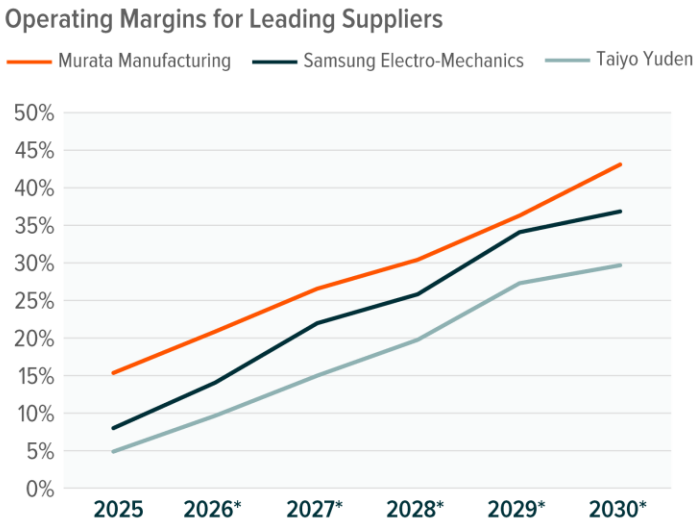
* Forecast
Source: J.P. Morgan. (2026, June 16). Asian MLCC Industry.

The global MLCC market could grow from $15 billion in 2025 to over $30 billion by 2030, with AI and Data Centers driving nearly 30% of all MLCC revenues by 2030.[22] MLCCs represent only a small share of an AI system's cost, but shortages of qualified components can delay shipments of far more valuable hardware. That gives the relatively small group of advanced suppliers strategic importance well beyond the absolute dollar size of the MLCC market.

Manufacturers are responding with targeted investments, but new capacity takes time. New production lines can require roughly two years to build, and the materials expertise needed to manufacture advanced products at high yields cannot be replicated quickly. Murata and Samsung Electro-Mechanics are expected to make large investments to scale production.[23] Yet global MLCC production capacity is expected to expand by only 10–15% annually through 2030, limiting supply response to accelerating demand.[24]

TOP THREE GLOBAL MLCC SUPPLIERS EXPECT REVENUE TO ACCELERATE AND MARGINS TO IMPROVE





* = Consensus Estimates.
Source: FactSet Research Systems. (n.d.). Data accessed on Aug 28, 2026.

Global X MLCC & Electronic Components ETF: Targeting the Passive Components Powering AI

We're launching the Global X MLCC & Electronic Components ETF (ticker MLCC), an actively managed ETF that invests in companies involved in MLCCs and electronic components.

Designed to stay focused on the gatekeepers of an emerging AI bottleneck, the strategy seeks to deliver access to a concentrated group of companies listed in Japan, South Korea, and Taiwan that either derive at least 50% of their revenue from MLCCs and related passive electronic components or rank as one of the three largest manufacturers of capacitors worldwide by revenue.

The approach centers on a concentrated group of up to fifteen qualifying companies, with the two largest qualifying companies generally receiving weights of 20%, while remaining holdings are weighted by free-float-adjusted market capitalization, capped at 15%. This structure deliberately concentrates exposure toward established industry suppliers of MLCCs and passive electronic components, where scale, manufacturing expertise, and constrained capacity can allow a greater share of the economics to accrue.

As demand for MLCCs expands faster than production capacity can scale, we expect these suppliers to benefit from higher volumes, greater capacity utilization, and stronger pricing power. With many of these companies listed overseas, the fund provides access to them through a single U.S.-listed ETF, focused on the suppliers of small but essential components underpinning power-dense AI hardware.

Conclusion: AI Surfaces an Emerging MLCC Bottleneck

As the market begins to price the broader AI hardware stack, attention is shifting beyond compute to the supporting components that make it possible, including passive components that regulate and stabilize power. Within this layer, MLCCs represent a tiny share of system cost, but they play a pivotal role in keeping increasingly power-dense servers stable and reliable. Their growing content per system, rising technical requirements, and concentrated supplier base create a distinct opportunity within the broader AI value chain, reinforced by demand from vehicle electrification, industrial automation, and connectivity.

For investors seeking to broaden their AI exposure beyond the most visible semiconductor names, the Global X MLCC & Electronic Components ETF (MLCC) offers targeted access to an essential but often-overlooked layer of the AI hardware value chain.

Related ETFs

MLCC – Global X MLCC & Electronic Components ETF

Click the fund name above to view current holdings. Holdings are subject to change.

Footnotes

1. Samsung Electro-Mechanics. (2026, February 23). Strategy for Responding to the AI Industry: Expanding a Three-Part Series on Computing, Power, and Network.
2. Goldman Sachs Research. (2026, April 22). Updating supply/demand heatmap for semis, components, and materials; tightness intensified YTD for AI servers.
3. Morgan Stanley Research. (2026, June 22). MLCC Super Cycle – The Other AI Squeeze.
4. Morgan Stanley Research. (2026, June 22). MLCC Super Cycle – The Other AI Squeeze.
5. Murata. (2021, May 3). Installing Electronic Circuits of Dramatically Increasing Size into Compact Devices - Murata's MLCC for 5G Smartphones (Part 1 of 2)
6. Samsung Electro-Mechanics. (2024, July 17). Samsung Electro-Mechanics Develops 2,000V High-Voltage MLCCs for Electric Vehicles.
7. Uptime Intelligence. (2025, July). Uptime Institute Global Data Center Survey 2025; Datacenters.com. (2026, August 23). 800V DC Is Coming: The Next Big Change Inside AI Data Centers.
8. Samsung Electro-Mechanics. (2025, March 5). Samsung Electro-Mechanics Industrial High Capacitance MLCC.
9. Aetrix. (2026, May 29). AI Server MLCC Shortages: Capacity Reallocation and High-Capacitance Pressure.
10. Utmel. (2026, June 2). AI Server MLCCs: Why NVIDIA Rubin Racks Require Over 600,000 Capacitors.
11. Goldman Sachs Research. (2026, May 28). What Matters Today: Token economics, Why you Should Buy MLCC Stocks, PCE Today, Consumer Sentiment At Record Lows.
12. Samsung Electro-Mechanics. (2025, July 21). Samsung Electro-Mechanics Bets Big on MLCC for AI Servers and Automotive Electronics — Reshaping its Business Around High-Growth Sectors.
13. Murata. (2021, June 23). Automotive MLCCs Balancing Reliability with Miniaturization and High Capacitance in a Closely Intertwined Evolution with the CASE Trend.
14. Samsung Electro-Mechanics. (2025, July 21). 'The Salt of the Electronics World' Samsung Electro-Mechanics Bets Big on MLCC for AI Servers and Automotive Electronics — Reshaping its Business Around High-Growth Sectors.
15. J.P. Morgan. (2026, June 12). Asian MLCC Industry.
16. Morgan Stanley. (2026, June 22). MLCC Super Cycle – The Other AI Squeeze.
17. TrendForce. (2026, June 17). Structural Shortages of High-End Specialty MLCCs May Emerge in 2H26, Says TrendForce.
18. TrendForce. (2026, July 6). AI Demand for High-End MLCCs Drives Japan and Korea Suppliers' Book-to-Bill Ratios to Post-Pandemic Highs, Raising Shortage Risks in 2H26, Says TrendForce.
19. TrendForce. (2026, August 31). MLCC Price Aug. 2026.
20. The Korea Herald. (2026, August 30). AI demand drives broader Samsung Electro-Mechanics MLCC price hikes.
21. Samsung Electro-Mechanics. (2026, September 1). Samsung Electro-Mechanics signed KRW 1.0722 Trillion Deal with a Global Major Corporation - AI Server MLCC Supply Contract.

22. Morgan Stanley. (2026, June 22). MLCC Super Cycle – The Other AI Squeeze.
23. Nikkei. (2025, August 14). Electronics maker Murata bets AI device boom coming around 2030.
24. Goldman Sachs Research. (2026, May 28). What Matters Today: Token economics, Why you Should Buy MLCC Stocks, PCE Today, Consumer Sentiment At Record Lows.

Glossary

Capacitor: An electronic component that temporarily stores and releases electrical charge, helping stabilize voltage, filter electrical noise, and deliver consistent power to electronic circuits.

GB200: NVIDIA's Grace Blackwell AI computing platform, combining Grace CPUs and Blackwell GPUs for large-scale AI training and inference. The GB200 NVL72 system integrates 72 Blackwell GPUs and 36 Grace CPUs in a liquid-cooled rack.

VR200: A shorthand commonly used for NVIDIA's next-generation Vera Rubin computing platform, which succeeds Grace Blackwell and combines Vera CPUs with Rubin GPUs for increasingly compute-intensive AI workloads. NVIDIA officially refers to the rack-scale system as Vera Rubin NVL72.

Passive Components: Electronic components that do not amplify or generate electrical signals, but instead help store, regulate, filter, protect, or control the flow of electricity within a circuit. Examples: capacitors, resistors, inductors, transformers, etc.

Book-to-Bill Ratio: The value of new orders received relative to products shipped or billed during a period. A ratio above 1.0 indicates that new orders are exceeding current sales.
