

TAIYO YUDEN

Industry-Leading High-Capacitance MLCCs Support Advanced DCUs for Autonomous Driving and ADAS

High-Density Power Design with 3225-Size, 220 μF/4 V MLCCs

— Significantly Reducing Board Space by Replacing Polymer Capacitors —

TAIYO YUDEN CO., LTD.
As of September 2026

01 ADAS and DCU Evolution is Reshaping Power Design

➢ Advances in SoC performance are driving demand for higher capacitance and lower impedance in power circuits

As autonomous driving capabilities advance, the computing performance of SoCs in ADAS domain controllers continues to increase. At higher levels of autonomous driving—L2+, L3, and eventually L4/L5—power consumption rises as systems process image recognition, sensor fusion, and AI inference. DCUs (domain control units) use low-voltage, high-current power rails, typically 0.5–3.3 V, to supply SoC cores. Power requirements can reach 100–450 W, making voltage stability during load transients critical.

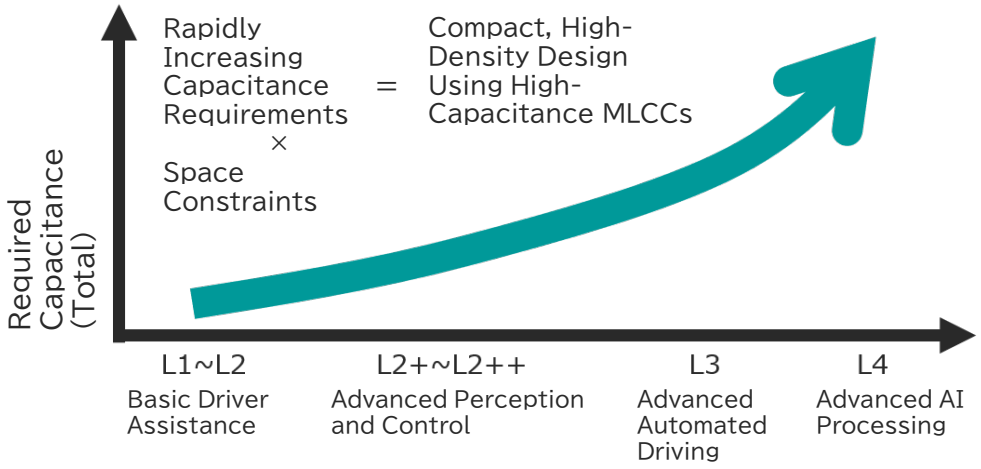
➢ Key Design Changes Driven by DCU Evolution

- ECU consolidation and domain-based architectures
- High-density integration of SoCs, memory, and PMICs
- Rising power consumption as computing performance increases
- Reduced PCB area
- Condensation and thermal shock challenges in liquid-cooled systems
- Component placement near mounting screws and PCB edges
- Evaluation of MLCCs as replacements for polymer capacitors

➢ Technology Trend

As autonomous driving capabilities advance, designs that have traditionally relied on polymer capacitors for bulk capacitance are increasingly shifting toward high-frequency, high-density decoupling with MLCCs.

➢ Increasing Capacitance Requirements at Higher Levels of Autonomous Driving



Autonomous Driving Levels and SoC Performance Requirements

02 Achieving 220 µF in a 3225-Size MLCC

➢ Secure higher capacitance within a limited PCB area

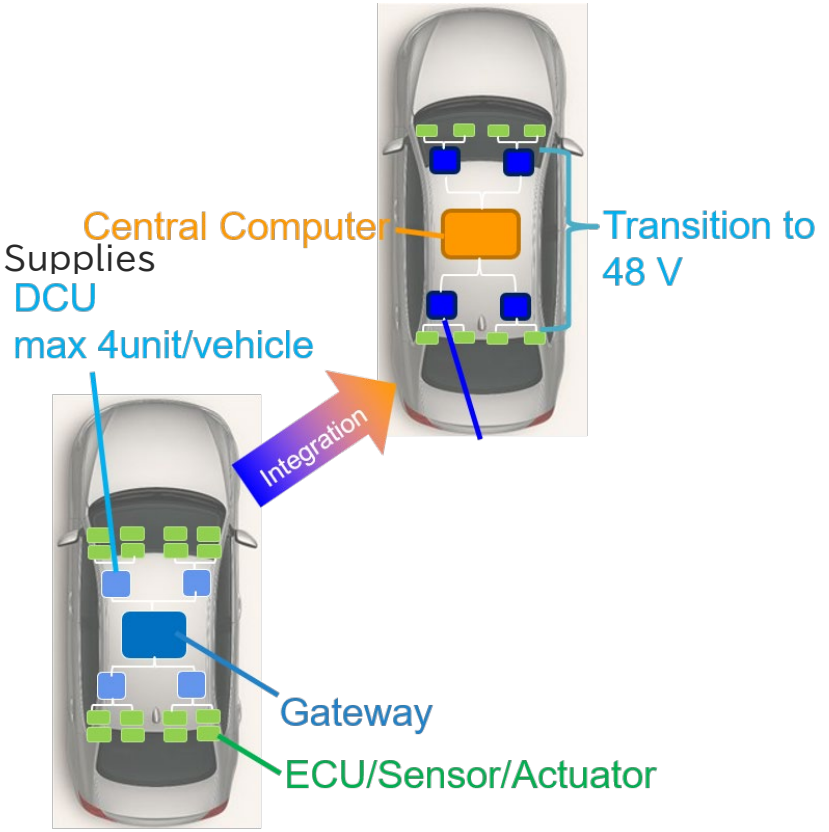
TAIYO YUDEN's 3225-size high-capacitance MLCC delivers 220 µF with a rated voltage of 4 V in a compact 3.2 × 2.5 mm footprint. Automotive DCUs require multiple capacitors placed close to SoCs and PMICs, while PCB miniaturization and higher component density leave limited space for them. The 3225-size, 220 µF, 4 V MLCC offers an option for increasing capacitance per unit area to address these design challenges.

➢ Key Specifications

- Case Size: 3225 (3.2 × 2.5 mm)
- Capacitance: 220 µF
- Rated Voltage: 4 V
- Temperature Characteristic: X7T
- Designed for high reliability in automotive applications
- Qualified to AEC-Q200
- High capacitance density helps reduce PCB area

➢ Potential Applications

- ADAS Domain Controllers
- Central Computers
- Cockpit Domain Controllers
- Automotive SoC and GPU Power Supplies
- Memory Power Supplies
- DC-DC Converter Outputs
- Decoupling around PMICs
- Body and Infotainment ECUs



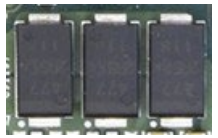
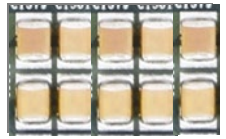
Design challenges in powering automotive SoC core rails, EDN

03 Mounting Comparison: Polymer Capacitors vs. MLCCs

➢ Helps increase capacitance density within the same PCB area

DCU power circuits may use multiple polymer capacitors to meet capacitance requirements. However, their relatively large size can make component placement and clearance from surrounding components challenging. Using multiple 3225-size high-capacitance MLCCs can help reduce the mounting area while providing the required total capacitance.

➢ Capacitance Comparison Example

	Polymer Capacitor		MLCC
Nominal Specifications	7.3mm×4.3mm 470uF		3.2mm×2.5mm 220uF
Example Configuration		=	
Total Nominal Capacitance	3 × 470 μF ⇒ 1,410uF	<	10 × 220 μF ⇒ 2,200uF

➢ Potential Benefits

- Increased total capacitance
- Reduced PCB area
- Greater flexibility in component placement
- Distributed placement around SoCs and PMICs
- Support for high-density mounting and ECU miniaturization

Rather than replacing polymer capacitors on a one-to-one basis, configuring MLCCs in parallel can help optimize the power supply design based on required capacitance, load transients, and frequency characteristics.

04 Improving Power Integrity with Low ESR and ESL

➢ Low-impedance power design for fast load transients

ADAS SoCs and GPUs can experience rapid changes in computational load, causing steep current transients and voltage fluctuations on power rails. Compared with polymer capacitors, MLCCs feature lower ESR and ESL, making it easier to achieve low impedance at high frequencies. Placing MLCCs close to SoCs and PMICs can help suppress voltage fluctuations during load transients.

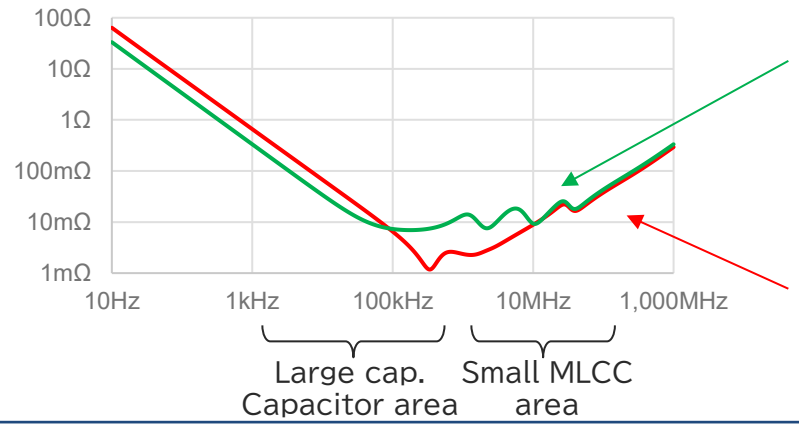
➢ Electrical Benefits of MLCCs

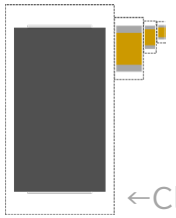
- Low impedance at high frequencies
- Power supply ripple suppression
- Reduced voltage fluctuations during rapid load changes
- Switching noise reduction

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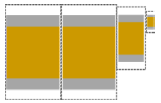
- Power stability and miniaturization
- High-density power circuit designs

[Downsizing Example] *Spice simulator





Ta polymer cap(7343/470μF)×1
+ MLCC(2012/10μF) + MLCC(1005/1μF) + MLCC(0603/0.1μF)
⇒ Gross mounting area : **51.4mm²**



MLCC(3225/220μF)×2
+ MLCC(2012/22μF) + MLCC(0603/0.1μF)
⇒ Gross mounting area : **25.3mm²**

✓Downsizing

※Actual characteristics vary depending on DC bias, temperature, frequency, mounting conditions, and the number of capacitors connected in parallel.

A configuration using high-capacitance MLCCs with low ESR and ESL can help stabilize the power supply while reducing circuit size and enabling higher-density layouts.

05 Supporting Long Operating Life in Automotive Environments

➢ High reliability under high temperatures, temperature cycling, and vibration

ADAS and DCUs are critical electronic systems responsible for vehicle safety control and perception processing. They must operate in more demanding environments than consumer electronics, including high temperatures, rapid temperature changes, vibration, and condensation. As ECUs become more integrated and liquid cooling becomes more common, components may also be exposed to thermal and mechanical stresses that differ from those in conventional designs.

➢ Potential Benefits of Using MLCCs

- Low ESR helps suppress heat generation from ripple current
- Compact, low-profile design provides greater placement flexibility
- Enables distributed placement close to SoCs
- Supports high-density mounting
- Supports evaluation and qualification against automotive quality standards
- Enables power supply designs that take long operating life into consideration

➢ Design Advantages

- Allows high capacitance to be placed close to SoCs
- Helps suppress localized voltage fluctuations on power lines
- Supports capacitance and current requirements through parallel connection
- Provides an option for evaluating replacement of polymer capacitors
- Can be used on PCBs with strict component-height and placement constraints

Note: Suitability for a specific application must be evaluated individually, taking into account rated voltage, DC bias characteristics, temperature characteristics, ripple current, PCB flexure, mounting conditions, and reliability requirements.

06 Summary

➢ 3225-Size, 220 µF MLCC: An Option for Power Design in the ADAS Era

As DCUs become more powerful and compact, power circuits require components that combine high capacitance, low impedance, and high reliability. Compared with conventional designs centered on larger capacitors, the 3225-size, 220 µF, 4 V high-capacitance MLCC offers the following benefits:

【Three Key Benefits】

1. High Capacitance Density

Delivers high capacitance in a compact size, allowing for more efficient use of PCB area.

2. Low ESR and ESL

Reduces impedance at high frequencies to help address rapid SoC load transients and power supply noise.

3. Long Operating Life and High Reliability

Designed with automotive reliability requirements in mind to support stable, long-term operation of ADAS and DCUs.

By combining expertise in materials, multilayering, and automotive reliability, TAIYO YUDEN offers a new option for next-generation DCU power supply design.

For the latest product specifications or design-in support, please contact your TAIYO YUDEN sales representative or visit TY-COMPAS, our online product search system.

Product Specifications TY-COMPAS

Contact Us