

LPCAMM2 & LPDDR5X Compression-Attached Memory Module Technical Report

Overcoming SO-DIMM High-Frequency Limits, 128-Bit Routing, and Laptop Repairability

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1. The Death of SO-DIMM at High Frequencies

Small Outline Dual In-line Memory Modules (SO-DIMMs) served the portable computing industry for 25 years. However, as memory data rates pushed past 5600 MT/s toward 8533 and 9600 MT/s, the mechanical edge-finger connector of SO-DIMM introduced intolerable stub capacitance and parasitic inductance. High-speed signal integrity collapsed, forcing laptop manufacturers to solder LPDDR5X directly to motherboards, destroying user upgradeability and circular repairability.

2. Architecture of the LPCAMM2 Compression Connector

Standardized under JEDEC standard JESD318, LPCAMM2 (Low Power Compression Attached Memory Module) replaces edge connectors with a Land Grid Array (LGA) compression connector. Using a specialized elastomeric or interposer pin array compressed with screws, LPCAMM2 provides direct, vertical, stub-free contact between module pads and motherboard traces, slashing parasitic inductance by over 70% and supporting speeds exceeding 9.6 Gbps.

3. 128-Bit Dual-Channel Integration on a Single Module

In traditional SO-DIMM designs, achieving a 128-bit memory bus required installing two separate physical modules side-by-side, occupying massive motherboard surface area. LPCAMM2 routes a complete 128-bit dual-channel LPDDR5X bus on a single ultra-compact module (roughly 78mm x 34mm), cutting physical PCB footprint by 64% while enabling LPDDR5X power-saving modes (deep sleep, DVFS).

4. Thermal Dissipation and Enterprise Deployment

Because LPDDR5X memory dies generate intense localized heat when operating at 9,600 MT/s, LPCAMM2 modules are integrated with a monolithic aluminum stiffener and heat spreader. System testing confirms that LPCAMM2 delivers up to 70% lower standby power dissipation than dual standard DDR5 SODIMMs while unlocking unprecedented 150+ GB/s memory bandwidth in thin-and-light mobile workstations.

Key Engineering Metrics & Reference Specifications

Memory Architecture	SO-DIMM (DDR5)	Soldered LPDDR5X	LPCAMM2 (LPDDR5X)
Max Data Transfer Rate	5,600 - 6,400 MT/s	8,533 - 9,600 MT/s	8,533 - 9,600 MT/s
Bus Width per Module	64-bit (Sub-channels)	128-bit (Direct Solder)	128-bit (Dual-Channel Integrated)

Connector Interface	262-pin Edge Finger	BGA Direct Solder	Compression LGA Array
PCB Footprint (128-bit)	~3,200 mm2 (2x Sockets)	~1,800 mm2 (Fixed)	~1,150 mm2 (Single Module)
User Upgradeable / Repairable	Yes (Thick Sockets)	No (Permanent)	Yes (Screw-Mount Compression)

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