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1-pH ESL Silicon Capacitor Tightens Voltage Regulation For AI Chips

[Empower Semiconductor's](#) EC1005P 16.6- μ F device is the largest silicon capacitor in the company's ECAP product family for high-frequency decoupling. The EC1005P is suitable for the most demanding power integrity targets as often found in high-performance systems-on-chip (SoCs). It features ultra-low impedance up to 1 GHz in a low profile that can be embedded into the substrate or interposer of any SoC, making it well suited for high-performance computing (HPC) and artificial intelligence (AI) applications, according to the vendor.

Offered in a 3.643-mm x 3.036-mm 120-pad chip-scale package, the EC1005P has an ultra-low sub-1-pH equivalent series inductance (ESL) and sub-3-m Ω ESR. The device comes in a standard profile of 784-micron that can be customized for various height requirements (see the figure and the table).

"The performance of SoCs and other large computing processors [is] constantly increasing," said Mukund Krishna, senior manager of product marketing, Empower Semiconductor. "It is becoming increasingly difficult to reach the level of power integrity and voltage regulation that these devices require with conventional MLCCs. The EC1005P features close-to-ideal parasitic parameters, allowing these SoCs to operate with reduced voltage margining and ultimately reducing system power."

The EC1005P ECAP leverages Empower's high-performance and high-density silicon capacitor technology to fulfill the "last inch" decoupling gap from the voltage regulators to the SoC supply pins. According to the company, this approach substitutes several discrete components with much lower performance and larger footprint, with a single monolithic device that provides optimal electrical performance and simplifies engineering complexity. Empower's silicon capacitors provide high stability over voltage and temperature and are not subject to derating or aging like traditional multi-layer ceramic capacitors (MLCCs).

The EC1005P ECAP is available for sampling now and will be in volume production in Q4 2024. For more information, see the ECAP [page](#).

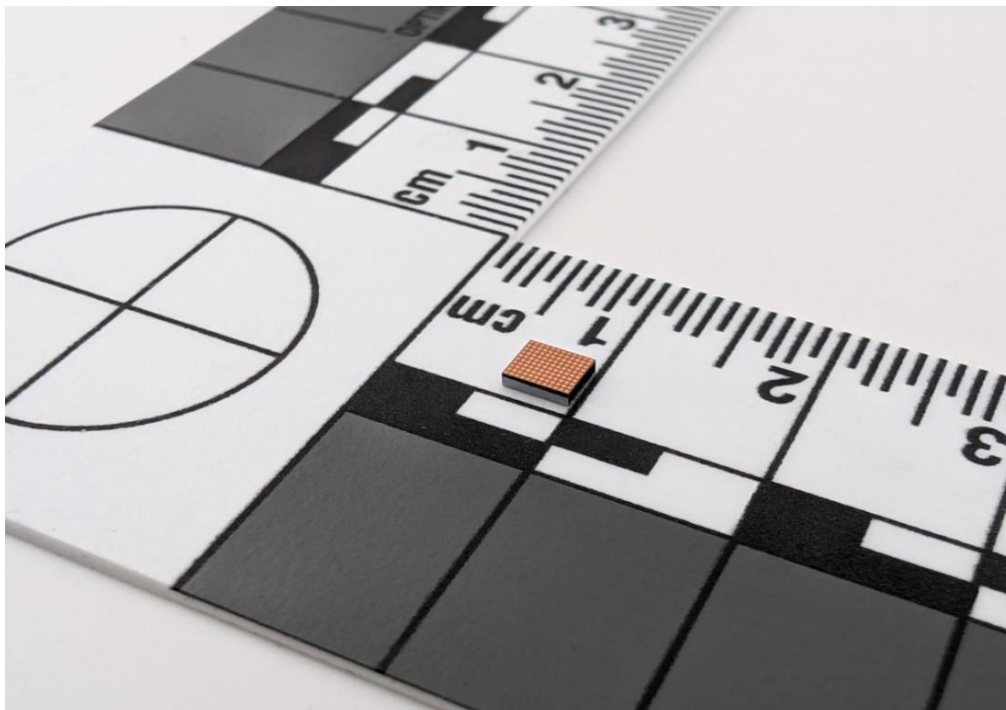


Figure. The EC1005P is a single 16.6- μ F capacitor suitable for the demanding power integrity requirements of HPC and AI applications. It can be embedded into the substrate or interposer of any SoC.

Table. The EC1005 is the largest silicon capacitor in the ECAP product family for high-frequency decoupling.

Part Number	Description	# of Capacitors	Capacitance	Operating Voltage	Package Type	Package Size (L x W) [mm]	Package Thickness [μm]
EC1001P	Ultra-low profile 200nF Silicon Capacitor	1	200nF	4.0V	CSP	1.0 x 0.5 (0402/1005m)	150
EC1002P	Ultra-low profile 215nF Silicon Capacitor	1	215nF	4.0V	CSP	1.0 x 0.5 (0402/1005m)	150
EC1004	Ultra-low profile silicon capacitor	1	240nF	4.0V	CSP	0.64 x 0.5	150
EC1005	Ultra-low profile silicon capacitor	1	16.6μF	2.0V	CSP	3.675 x 3.06	784
EC2012	Ultra-low profile silicon capacitor	2	2x 1.2nF	4.0V	CSP	0.5 x 0.25	100
EC1100P	Ultra-low profile 670nF Silicon Capacitor Array	5	110nF x 3, 145nF and 200nF	4.0V	CSP	2.5 x 0.6	150
EC2047B	Ultra-low profile 4,800nF Silicon Capacitor Array	17	1x 600nF, 11x 200nF, 5x 400nF	2.0V	CSP	2.3 x 1.9	200