EMPOWER SEMICONDUCTOR

Silicon Capacitors - ECAPs

Product Brief

Features

- **Deep trench capacitor technology**
- **Electrical performance**
  - Ultra-low Equivalent Series Inductance (ESL)
  - Ultra-low Equivalent Series Resistance (ESR)
  - Wide bandwidth 10MHz – 10GHz
- **Form factor and integration**
  - Ultra-thin profile: down to 50 µm
  - High capacitance density per volume
  - Die/land side mounting or substrate embedding
  - Bump or pad terminations
  - Single and multi domains configurations
- **Stability and reliability**
  - No DC or AC bias derating
  - No aging or temperature derating
  - No ferromagnetic material
  - No audible noise susceptibility
  - -40°C to 125°C temperature range

Applications

- Power and signal integrity
- Low ESL/ESR power delivery network
- High speed computing and AI
- Mobile Processors

Power and Signal Integrity

Silicon capacitors offer an exceptional combination of electrical performance, wide bandwidth, stability, and reliability providing the highest level of power and signal integrity for high-speed circuitry such as AI and HPC processors.

Unlike traditional MLCC (Multilayer Ceramic Capacitor) technology, silicon capacitors exhibit ultra-low Equivalent Series Inductance (ESL) and Equivalent Series Resistance (ESR), respectively in the picohenry and milliohm range, ensuring superior high-frequency stability with minimal signal distortion. Their capacitance remains highly stable over temperature, voltage, and aging, eliminating any capacitance deterioration due to AC and DC voltage bias effects.

With a high capacitance density per volume and the ability to combine multiple capacitor domains into a monolithic die, silicon capacitors advantageously replace large arrays of MLCCs typically located underneath large SoCs. They provide the necessary miniaturization required by space constrained applications and high-density boards.

The ultra-thin form factor of silicon capacitors, down to 50 µm, also enables seamless integration into semiconductor packages or into the SoC substrates, reducing parasitics and improving signal integrity by providing the lowest impedance power delivery network to the high-speed processors.

Typical Applications

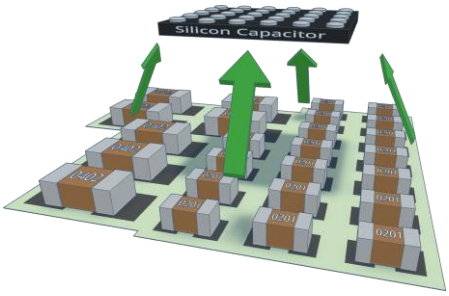

Figure 1: Monolithic integration of multiple capacitors

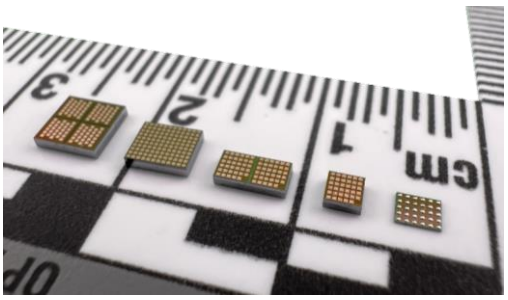

Figure 2: Die/land side mounting or in-substrate embedding

Standard Silicon Capacitor Portfolio

Part Number	# Capacitors	Capacitance		Max Operating Voltage	Package Size	Pad Type	Mounting
EC2012B	2	2.4nF	2x 1.2nF	4.0V	0.5 x 0.25 mm^2	Flat bump	Die/land side
EC1001P	1	200nF		4.0V	1.0 x 0.5 mm^2	Copper pad	Die/land side
EC1002P	1	215nF		4.0V	1.0 x 0.5 mm^2	Copper pad	Die/land side
EC1004B	1	230nF		2.0V	0.64 x 0.5 mm^2	Standard bump	Die/land side
EC2004B	2	460nF	2x 230nF	2.0V	0.64 x 1.0 mm^2	Standard bump	Die/land side
EC1100P	5	670nF	1x 146nF 3x 110nF 1x 200nF	4.0V	2.5 x 0.6 mm^2	Copper pad	Die/land side
EC1007B	1	1.8µF		1.2V	1.12 x 0.98 mm^2	Standard bump	Die/land side
EC2047B	17	4.8µF	11x 200nF 5x 400nF 1x 600nF	2.0V	2.3 x 1.9 mm^2	Standard bump	Die/land side
EC2005P	2	9.34µF	2x 4.67µF	1.2V	2.0 x 2.0 mm^2	Copper pad	Embedded
EC1005P	1	16.7µF		1.5V	3.64 x 3.06 mm^2	Copper pad	Embedded
EC2025P	4	18.68µF	4x 4.67µF	1.2V	4.04 x 2.0 mm^2	Copper pad	Embedded
EC2006P	4	36.8µF	4x 9.2µF	1.2V	4.0 x 4.0 mm^2	Copper pad	Embedded

Custom Silicon Capacitor Design Services

Empower Semiconductor offers custom design services for defining, designing and manufacturing silicon capacitors, enabling tailored solutions to meet specific application performance and physical/mechanical requirements.

Unlike standard components, custom solutions provide full flexibility in capacitor customization, including capacitance and domains configuration, target ESL and ESR metrics, X and Y dimensions, total thickness and pad or bump terminations for seamless integration into different assembly processes, including flip-chip, wire bonding and in substrate embedding techniques.

Multiple capacitance domains can coexist on a same die, partitioning capacitance across multiple power rails, reducing parasitics and enhancing power integrity. This level of customization ensures that Empower's silicon capacitors meet the exact electrical and mechanical performance requirements of high-speed applications such as AI, xPU. Mobile and HPC high speed processors.

For information regarding Empower Semiconductor, Inc., and its products, visit www.empowersemi.com

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