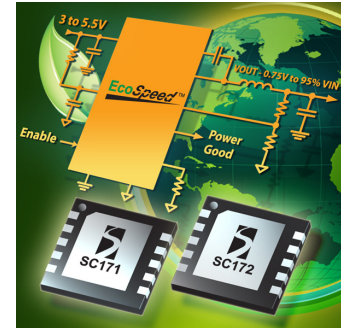


Product Overview



SEMTECH POWER MANAGEMENT

EcoSpeed® DC-DC Converters: Best-in-Class Performance for Dynamic Point-of-Load Applications



Unique buck converter platform provides ultra-fast transient response and high efficiency across the entire load range.

Description

The EcoSpeed® converter platform incorporates Semtech's patented⁽¹⁾ adaptive on-time (AOT) control architecture to deliver:

- Very high efficiency across the entire load range
- Ultra-fast transient response
- Easy-to-use, small and highly integrated DC-DC converters

This unique architecture offers the benefits of conventional converter topologies with optimal tradeoffs for best-in-class performance in next-generation dynamic point-of-load applications.

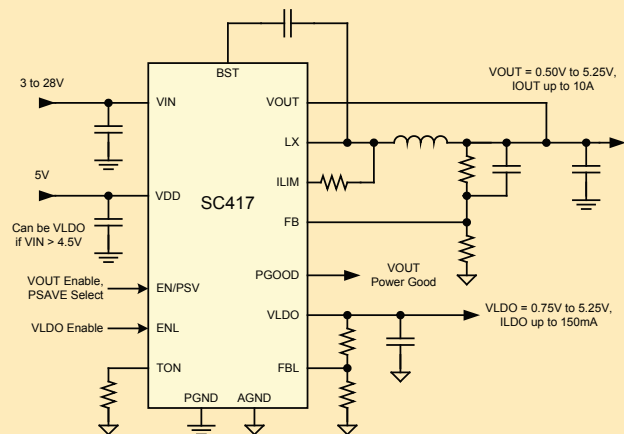
These buck converters are inherently well suited to implement a reduced frequency power-save (PSAVE) mode for up to 95% peak efficiency in light load conditions, with the option of ultrasonic PSAVE mode for applications requiring no audible resonance during power save.

Semtech's EcoSpeed converters minimize output capacitance, eliminate the need for external compensation components and enable the use of ceramic input/output capacitors to provide a simple, space-saving and low-cost solution.

(1) U.S. Patent No. 7,714,547

Key Features

- Patented adaptive on-time control architecture
 - Ultra-fast transient response
 - Pseudo-fixed switching frequency typically $\pm 15\%$ accuracy
 - Programmable switching frequency: 200kHz to 1MHz
 - Very high efficiency across the entire load range
 - No external compensation components required
 - Up to 95% peak standby efficiency
- Power save (PSAVE) maximizes light load efficiency
- Wide input voltage range: 3V to 28V
- Output current range: 1A to 30A
- SmartDrive™ technology reduces EMI
- Low profile MLPQ and MLPD packages



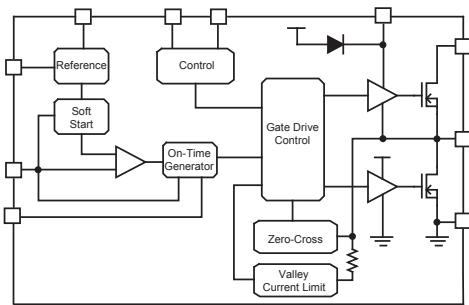
EcoSpeed DC-DC Converter Product Portfolio

Orderable Part#	Type	On-Chip LDO?	V _{IN} Range	V _{DD} Range	V _{OUT} Range	I _{OUT} (max)	PGOOD	Enable	PSAVE	Package
SC171	Regulator	No	3 - 5.5V	3 - 5.5V	0.75 to 95% VIN	1A	Yes	Yes	Ultrasonic	MLPD-10 (3 x 3 x 1mm)
SC172	Regulator	No	3 - 5.5V	3 - 5.5V	0.75 to 95% VIN	2A	Yes	Yes	Ultrasonic	MLPD-10 (3 x 3 x 1mm)
SC173	Regulator	No	3 - 5.5V	3 - 5.5V	0.75 to 95% VIN	3A	Yes	Yes	Ultrasonic	MLPD-10 (3 x 3 x 1mm)
SC173A	Regulator	No	3 - 5.5V	3 - 5.5V	0.75 to 95% VIN	3A	Yes	Yes	Regular	MLPD-10 (3 x 3 x 1mm)
SC174	Regulator	No	3 - 5.5V	3 - 5.5V	0.75 to 95% VIN	4A	Yes	Yes	Ultrasonic	MLPD-10 (3 x 3 x 1mm)
SC401B	Regulator	Yes	3 - 17V	3 - 5.5V	0.6 to 5.5V	15A	Yes	Yes	Ultrasonic	MLPQ-32 (5 x 5 x 1mm)
SC402B	Regulator	Yes	3 - 28V	3 - 5.5V	0.6 to 5.5V	10A	Yes	Yes	Ultrasonic	MLPQ-32 (5 x 5 x 1mm)
SC403B	Regulator	Yes	3 - 28V	3 - 5.5V	0.6 to 5.5V	6A	Yes	Yes	Ultrasonic	MLPQ-32 (5 x 5 x 1mm)
SC410	Regulator	Yes	5.5V to 24V	n/a	0.75 to 7.5V	3A	Yes	Yes	Ultrasonic	MLPD-10 (3 x 3 x 1mm)
SC414	Regulator	Yes	3 - 28V	3 - 5.5V	0.75 to 5.5V	6A	Yes	Yes	Ultrasonic	MLPQ-28 (4 x 4 x 1mm) MLPQ-32 (5 x 5 x 1.0mm)
SC417	Regulator	Yes	3 - 28V	4.5 - 5.5V	0.5 to 5.5V	10A	Yes	Yes	Ultrasonic	MLPQ-32 (5 x 5 x 1mm)
SC418	PWM Controller	Yes	3 - 28V	3 - 5.5V	0.5 to 5.5V	30A*	Yes	Yes	Prog. Ultrasonic or Regular	MLPQ-UT-20 (3 x 3 x 0.6mm)
SC419	PWM Controller	No	3 - 28V	4.5 - 5.5V	0.5 to 5.5V	30A*	Yes	Yes	Prog. Ultrasonic or Regular	MLPQ-UT-20 (3 x 3 x 0.6mm)
SC424	Regulator	Yes	3 - 28V	3 - 5.5V	0.75 to 5.5V	6A	Yes	Yes	Regular	MLPQ-28 (4 x 4 x 1mm)
SC427	Regulator	Yes	3 - 28V	4.5 - 5.5V	0.5 to 5.5V	10A	Yes	Yes	Regular	MLPQ-32 (5 x 5 x 1mm)
SC493	I ² C Controller	No	3 - 28V	3 - 5.5V	0.5 to 5.0V	30A*	Yes	Yes	Prog. Ultrasonic or Regular	MLPQ-UT-20 (3 x 3 x 0.6mm)

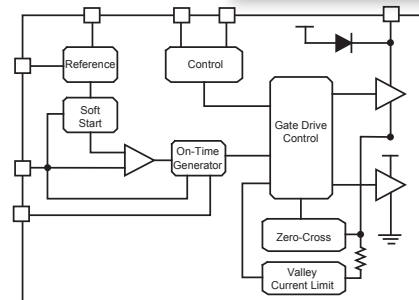
* External FET drive

EcoSpeed DC-DC Converter Block Diagrams

Controller & Regulator



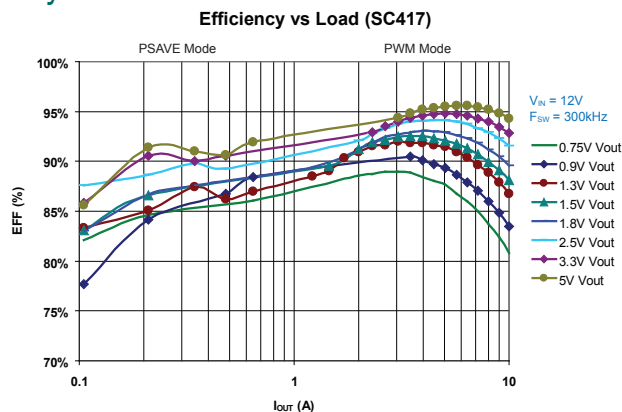
Regulator



Controller

High Efficiency

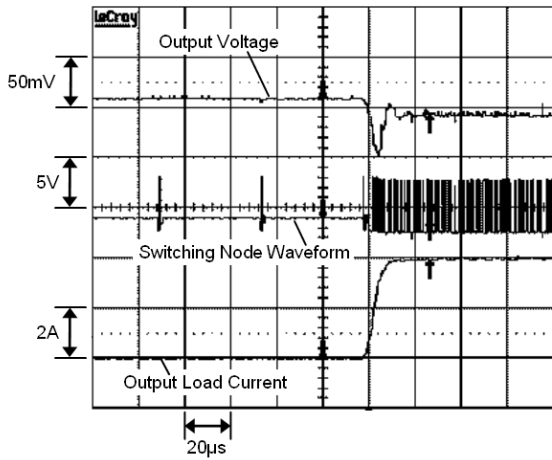
Excellent Efficiency Even at Light Loads



Excellent Transient Response

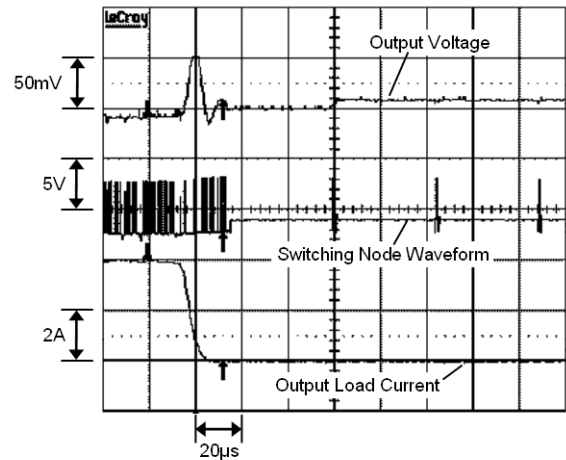
Load Transient Response — Load Rising (SC174)

($V_{IN} = 5V, V_{OUT} = 1.2V$)



Load Transient Response — Load Falling (SC174)

($V_{IN} = 5V, V_{OUT} = 1.2V$)



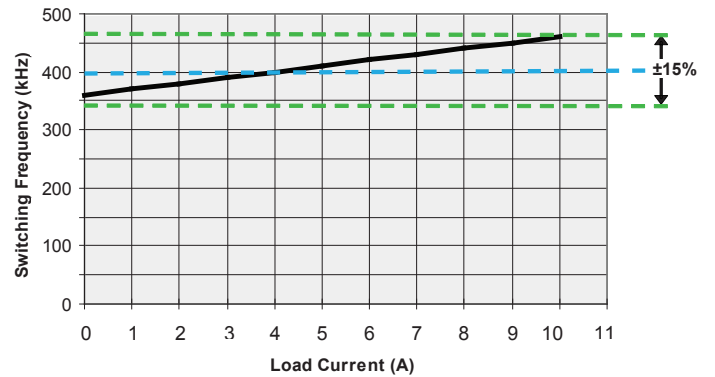
Programmable Pseudo-Fixed Frequency

Many applications are sensitive to DC-DC converter frequency and require a fixed frequency to ensure that inductor-radiated EMI is in a known and acceptable band. Conventional current mode and voltage mode conversion architectures have a fixed frequency with an accuracy typically up to $\pm 20\%$. Other topologies, including simple hysteretic, or the fast-responding constant on-time mode, generally have frequencies that are unpredictable with limited ability to control the extreme variations in frequency due to input and output conditions.

Semtech's EcoSpeed converters offer a programmable frequency from 200kHz to 1MHz, which is maintained with an accuracy of typically $\pm 15\%$ – similar to many conventional fixed frequency implementations.

Tightly Controlled Programmable Frequency

Switching Frequency (SC417)



Frequency Programmable from 200kHz to 1MHz

SmartDrive™ Technology

SmartDrive™ Reduces EMI

SmartDrive technology is Semtech's approach to implementing the converter gate drive circuitry to reduce EMI. EMI is usually a problem during the turn-on of the high-side FET in a buck converter power stage. This is due to the reverse recovery charge current, which results in a high spike from the body diode of the low-side FET. To avoid this, all Semtech EcoSpeed products incorporate a two-step, high-side FET turn-on

scheme. The first step is a weak turn-on to allow the reverse recovery current to pass through. The second step is a full turn-on to quickly transition the inductor phase node to V_{IN} with minimal power loss. This approach reduces EMI, while maintaining high efficiency.

PSAVE: Low Standby Power and Fast Wake-Up Response

Power efficiency in standby mode is increasingly important for today's "green" initiatives. However, most electronic products also require fast "wake-up" capability, which demands fast recovery from low-power standby to full-power operation. To solve this problem, EcoSpeed DC-DC converters offer a power-save (PSAVE) mode, which lowers the switching frequency to cater to the light load requirement during standby. This improves efficiency during light loads by reducing the switching losses associated with the power FET gate charge. Since the EcoSpeed architecture responds on a cycle-by-cycle basis, when the load flips from light to full conditions, the converter can quickly exit PSAVE mode providing fast wake-up response time.

Several EcoSpeed DC-DC converters also offer an ultrasonic PSAVE (UPSAVE) feature, which ensures that the device switching frequency stays above a 25kHz threshold to eliminate audible resonance.

Additionally, all EcoSpeed devices offer smart PSAVE, which is designed to prevent the output voltage from floating higher than 10% by turning on the low-side power FET and draining any excess charge from C_{OUT} . This ensures that in light load conditions the converter does not hit a false OVP.

How Do EcoSpeed Converters Compare to Conventional Architectures?

The EcoSpeed buck converter platform incorporates the best of current mode, voltage mode and constant on-time control topologies, with minimal tradeoffs. The key to these performance advantages is Semtech's patent-pending adaptive on-time control (AOT) architecture, which uses an advanced control loop to dynamically adjust the on-time based on input voltage and output voltage. This results in a pseudo-fixed frequency operation and very predictable EMI, comparable to

existing voltage and current mode topologies and better than constant on-time architectures. Unlike conventional voltage and current mode control topologies, the AOT architecture eliminates the need for external error amplifiers, simplifying design and reducing component count. Additionally, Semtech's AOT architecture works with all capacitor chemistries for design flexibility and optimized BOM costs.

EcoSpeed Architecture Provides Optimal Trade-Offs

Function	Current Mode Control	Voltage Mode Control	Constant On-Time	EcoSpeed® Adaptive On-Time
Line Regulation	Excellent	Good	Excellent	Excellent
Load Regulation	Excellent	Moderate	Excellent	Excellent
External Compensation	Single Pole	Double Pole	None	None
Stable Operation with Wide Range of Load Capacitance	Yes	No	No	Yes
Switching Frequency	Constant	Constant	Variable	Pseudo-Constant
Simple, Cost-Effective Architecture	No	No	Yes	Yes
Loop Response	Fast	Slow	Ultra-Fast	Ultra-Fast
C_{OUT}	Flexible	Somewhat Limited	Somewhat limited	Flexible
PSAVE	Not Inherent	Not Inherent	Inherent	Inherent
PCB Layout Sensitivity	Yes	No	Yes	Yes

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