ACE7216C

1.5A 2MHz Synchronous Buck Converter

Description

The ACE7216C is a high-efficiency, DC-to-DC step-down switching regulators, capable of delivering up to 1.5A of output current. The device operates from an input voltage range of 2.6V to 5.5V and provides an output voltage from 0.6V to VIN. Working at a fixed frequency of 2MHz allows the use of small external components, such as ceramic input and output caps, as well as small inductors, while still providing low output ripples. This low noise output along with its excellent efficiency achieved by the internal synchronous rectifier, making ACE7216C an ideal replacement for large power consuming linear regulators. Internal soft-start control circuitry reduces inrush current. Short-circuit and thermal shutdown protection improves design reliability. The ACE7216C is available in the tiny DFN2*2-6 package.

Features

- High Efficiency: Up to 97%
- Up to 1.5A Max output current
- 2MHz switching frequency
- Low dropout 100% duty operation
- Internal compensation and soft-start
- Current mode control
- Reference 0.6V
- Logic control shutdown (IQ<1uA)
- Thermal shutdown, UVLO
- Available in the tiny DFN2*2-6

Application

- Cellular phones
- Digital cameras
- MP3 and MP4 players
- Set top boxes
- Wireless and DSL modems
- USB supplied devices in notebooks
- Portable devices

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Absolute Maximum Ratings

Parameter		Value
Max Input Voltage		8V
Max Operating Junction Temperature(T_J)		125℃
Ambient Temperature(T_A)		-40℃~85℃
Maximum power dissipation	DFN2*2-6	600mW
Package thermalresistance(θ_{JA})		95℃/W
Storage Temperature(Ts)		-40℃~150℃
Lead Temperature & Time		260℃,10S
ESD (HBM)		>2000V

Note: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

Packaging Type

DFN2*2-6
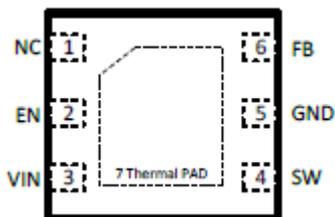
| Pin NO.	Description	Function
1	NC	No connection.
2	EN	Enable pin for the IC. Drive the pin to high to enable the part, and low to disable.
3	VIN	Supply voltage.
4	SW	Inductor connection. Connect an inductor between SW and the regulator output.
5	GND	Ground.
6	FB	Feedback input. Connect an external resistor divider from the output to FB and GND to set the output to a voltage between 0.6V and Vin.
7	Thermal PAD	Ground.

Ordering information

ACE7216C <u>XX</u>+ H

— Halogen - free

— Pb - free

— MN: DFN2*2-6
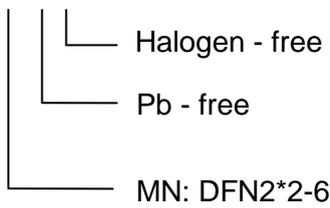
Typical Application
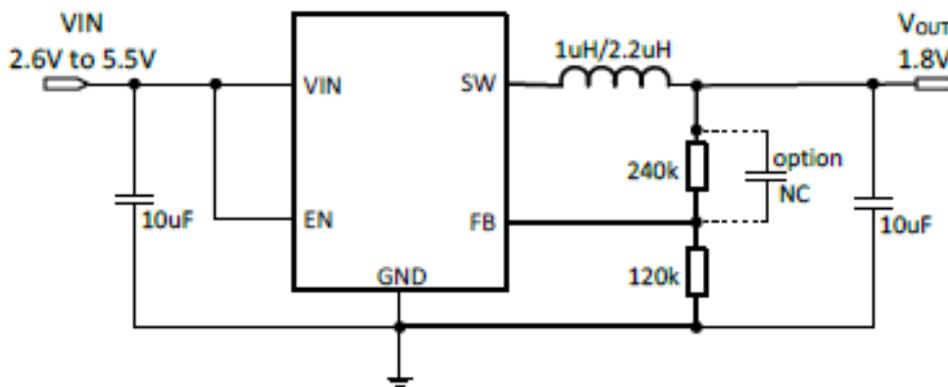
Block Diagram
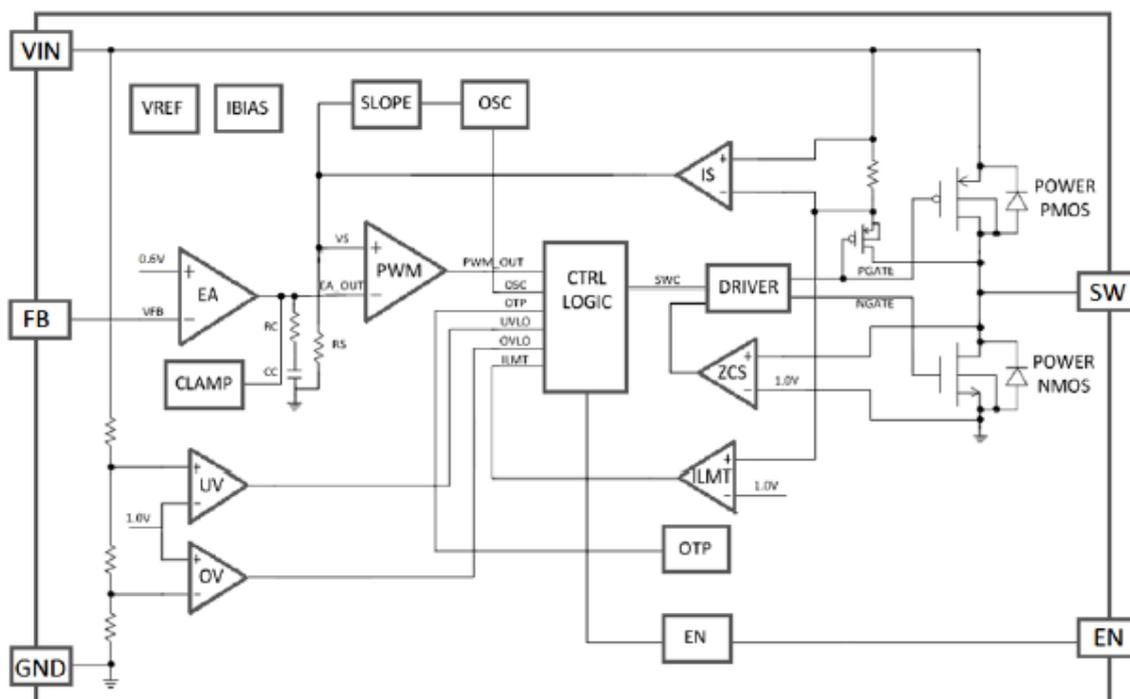
Electrical Characteristics

(V_{IN}=5V, T_A=25°C, unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	Input voltage range		2.6		5.5	V
V_{OVP}	Input overvoltage threshold			6.1		V
V_{REF}	Feedback voltage	Vin=5V	0.588	0.6	0.612	V
I_{FB}	Feedback leakage current			0.1	1	uA
I_Q	Quiescent current	Active, V_{FB}=0.65, No Switching		80		uA
$I_{SHUTDOWN}$	Shutdown input current	EN=0V			1	uA
LNR	Line regulation	Vin=2.6V to 5.5V		0.1	0.2	%/V
LDR	Load regulation	Iout=0.01 to 1A		0.1	0.2	%/A
F_{SOC}	Switching frequency		1.6	2	2.4	MHz
R_{DSON_P}	PMOS Rdson			250	350	mohm
R_{DSON_N}	NMOS Rdson			150	250	mohm
V_{UVLO}	Under voltage lockout		1.9	2.1	2.3	V
V_{UVLO_HY}	UVLO hysteresis			100		mV
I_{LIMIT}	Peak current limit		1.8	2.3	2.8	A
I_{NOLOAD}		Vin=5V, Vout=3.3V, Iout=0A		80		uA
I_{SWLK}	SW leakage current	Vin=6V, V_{SW}=0 or 6V, EN=0V			1	uA
I_{ENLK}	EN leakage current				1	uA
V_{H_EN}	EN input high voltage		1.2			V
V_{L_EN}	EN input low voltage				0.5	V
T_{SD}	Thermal shutdown temp			160		°C
T_{SH}	Thermal shutdown hysteresis			15		°C

Electrical Performance

Tested under, TA=25℃, unless otherwise specified

Efficiency vs. Output Current
(Vout=1.2V)
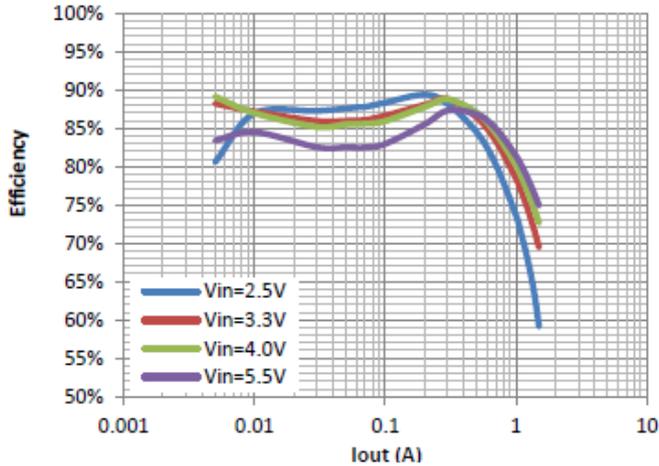
Efficiency vs. Output Current
(Vout=1.8V)
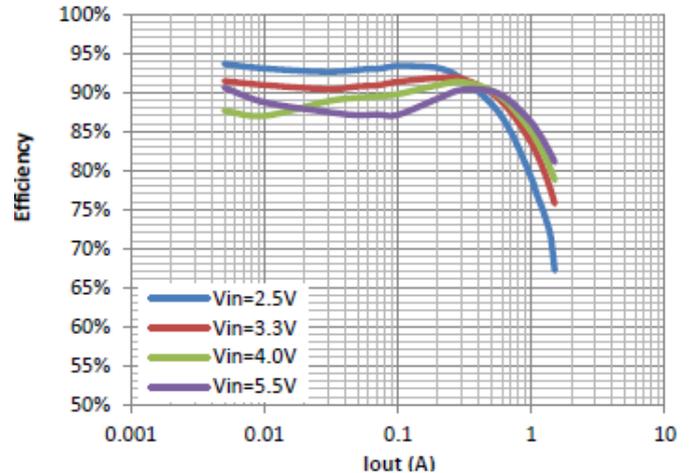
Efficiency vs. Output Current
(Vout=3.3V)
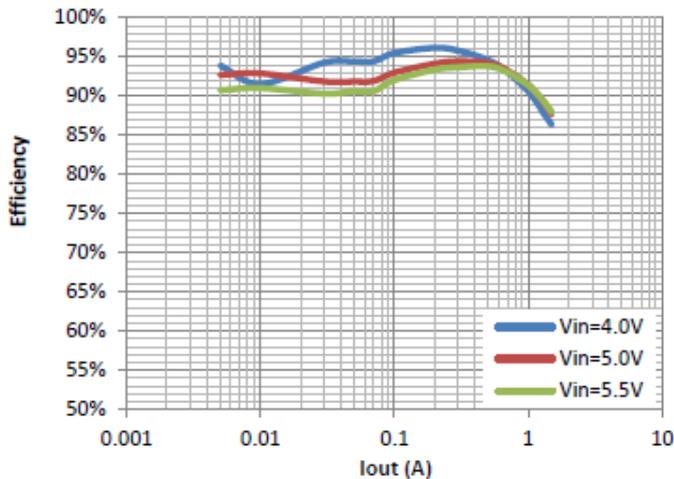
Output Ripple and SW at 1A load
Vin=5V / Vout=1.8V
Ch2—Vout ripple, Ch3—Vsw, Ch4—I$_{SW}$
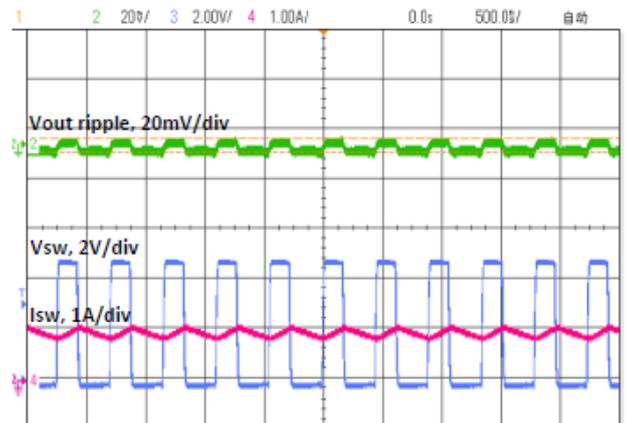
Load Transient
Vin=5V / Vout=1.2V / Iout=0.01~1.5A
Ch2—Vout ripple, Ch4—Iout
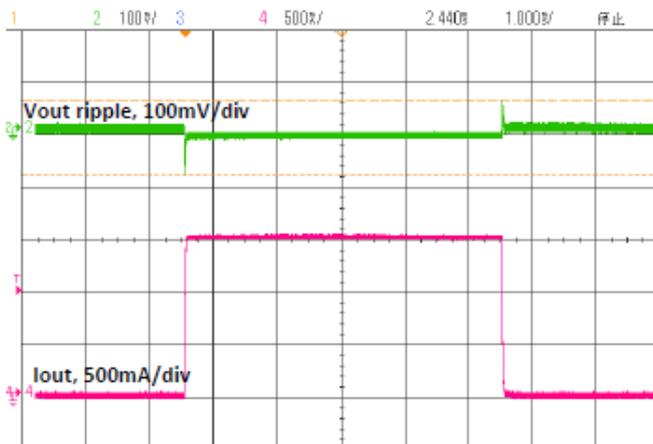
Load Transient
Vin=5V / Vout=3.3V / Iout=0.01~1.5A
Ch2—Vout ripple, Ch4—Iout
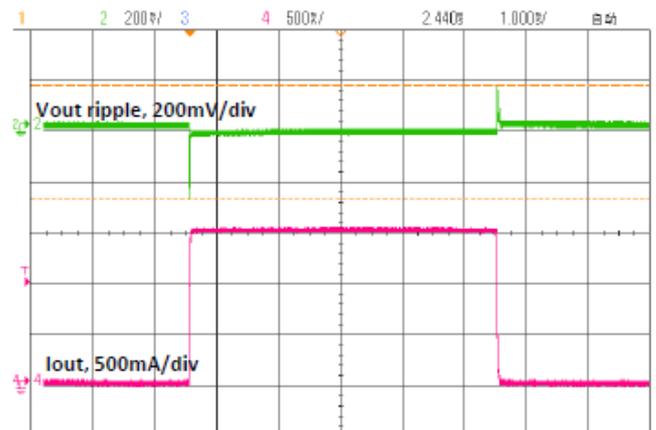
Detailed Description

The ACE7216C high-efficiency switching regulator is a small, simple, DC-to-DC step-down converter capable of delivering up to 1.5A of output current. The device operates in pulse-width modulation (PWM) at 2MHz from a 2.6V to 5.5V input voltage and provides an output voltage from 0.6V to VIN, making the ACE7216C ideal for on-board post- regulation applications. An internal synchronous rectifier improves efficiency and eliminates the typical Scotty free-wheeling diode. Using the on resistance of the internal high-side MOSFET to sense switching currents eliminates current-sense resistors, further improving efficiency and cost.

Loop Operation

ACE7216C uses a PWM current-mode control scheme. An open-loop comparator compares the integrated voltage-feedback signal against the sum of the amplified current-sense signal and the slope compensation ramp. At each rising edge of the internal clock, the internal high-side MOSFET turns on until the PWM comparator terminates the on cycle. During this on-time, current ramps up through the inductor, sourcing current to the output and storing energy in the inductor. The current mode feedback system regulates the peak inductor current as a function of the output voltage error signal. During the off cycle, the internal high- side P-channel MOSFET turns off, and the internal low-side N-channel MOSFET turns on. The inductor releases the stored energy as its current ramps down while still providing current to the output.

Current Sense

An internal current-sense amplifier senses the current through the high-side MOSFET during on time and produces a proportional current signal, which is used to sum with the slope compensation signal. The summed signal then is compared with the error amplifier output by the PWM comparator to terminate the on cycle.

Current Limit

There is a cycle-by-cycle current limit on the high- side MOSFET of 2.3A(typ). When the current flowing out of SW exceeds this limit, the high-side MOSFET turns off and the synchronous rectifier turns on. ACE7216C utilizes a frequency fold-back mode to prevent overheating during short-circuit output conditions. The device enters frequency fold-back mode when the FB voltage drops below 100mV, limiting the current to 2.3A (typ) and reducing power dissipation. Normal operation resumes upon removal of the short-circuit condition.

Soft-start

ACE7216C has a internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO), shutdown mode, or restarts following a thermal-overload event, the l soft-start circuitry slowly ramps up current available at SW.

UVLO and Thermal Shutdown

If VIN drops below 2.1V, the UVLO circuit inhibits switching. Once VIN rises above 2.2V, the UVLO clears, and the soft-start sequence activates. Thermal shutdown protection limits total power dissipation in the device. When the junction temperature exceeds TJ= +160°C, a thermal sensor forces the device into shutdown, allowing the die to cool. The thermal sensor turns the device on again after the junction temperature cools by 15°C, resulting in a pulsed output during continuous overload conditions. Following a thermal-shutdown condition, the soft-start sequence begins

Design Procedure
Setting Output Voltages

Output voltages are set by external resistors. The FB_ threshold is 0.6V.

$$R_{TOP} = R_{BOTTOM} \times \left(\frac{V_{OUT}}{0.6} - 1\right)$$

Input Capacitor Selection

The input capacitor in a DC-to-DC converter reduces current peaks drawn from the battery or other input power source and reduces switching noise in the controller. The impedance of the input capacitor at the switching frequency should be less than that of the input source so high-frequency switching currents do not pass through the input source. The output capacitor keeps output ripple small and ensures control-loop stability. The output capacitor must also have low impedance at the switching frequency. Ceramic, polymer, and tantalum capacitors are suitable, with ceramic exhibiting the lowest ESR and high-frequency impedance. Output ripple with a ceramic output capacitor is approximately as follows:

$$\Delta I_L = \frac{V_{OUT}}{L \times f_S} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

$$\Delta V_{OUT} = \frac{V_{OUT}}{8 \times f_S^2 \times L \times C_{OUT}} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

If the capacitor has significant ESR, the output ripple component due to capacitor ESR is as follows:

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_S \times L} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right) \times R_{ESR}$$

Packing Information

Package	DFN2x2-6	Devices per reel	3000	Unit	mm

Package specification：

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.25	0.30	0.35
c	0.18	0.20	0.25
D	1.95	2.00	2.05
D2	1.00	1.23	1.45
e	0.65BSC		
Nd	1.30BSC		
E	1.95	2.00	2.05
E2	0.50	0.68	0.85
L	0.25	0.30	0.40
h	0.10	0.15	0.20
载体尺寸（mil）	63*43		

Notes

ACE does not assume any responsibility for use as critical components in life support devices or systems without the express written approval of the president and general counsel of ACE Electronics Co., LTD. As sued herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and shoes failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.

2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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