

HIGH EFFICIENCY STEP-DOWN DC/DC CONVERTER WITH ADJUSTABLE CURRENT LIMIT FOR AUTOMOTIVE APPLICATIONS

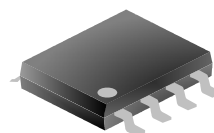
DESCRIPTION

The SD45216 is a high efficiency step down DC-DC converter with adjustable current limit in compact ESOP-8 package, including an error amplifier, ramp generator, current comparator, slope compensation, current sense and logic driver. It also integrates a current error amplifier to have a constant voltage and constant current control.

Peak current mode PWM control with external adjustable compensation provides a stable and high efficient operation over a wide range of load currents. By means of an on board current sense resistor and the availability of the current sense pins, a current limit programming is very simple and accurate.

The internal robust PMOS transistor with a typical of 100 mΩ assures high efficiency even at high output current level. The internal limiting current of typical value of 3.5 A, output short and over temperature protection, protect the device from accidental damage.

The internal fixed switching frequency of 120 kHz, and the ESOP-8 package pin allow building an ultra compact DC/ DC converter with a minimum board space.



ESOP-8-225-1.27
(With heatsink at the bottom)

APPLICATIONS

- * Automotive applications
- * Chargers for NiCd, NiMH batteries
- * Simple step-down converters with adjustable current limit
- * Adjustable current generator

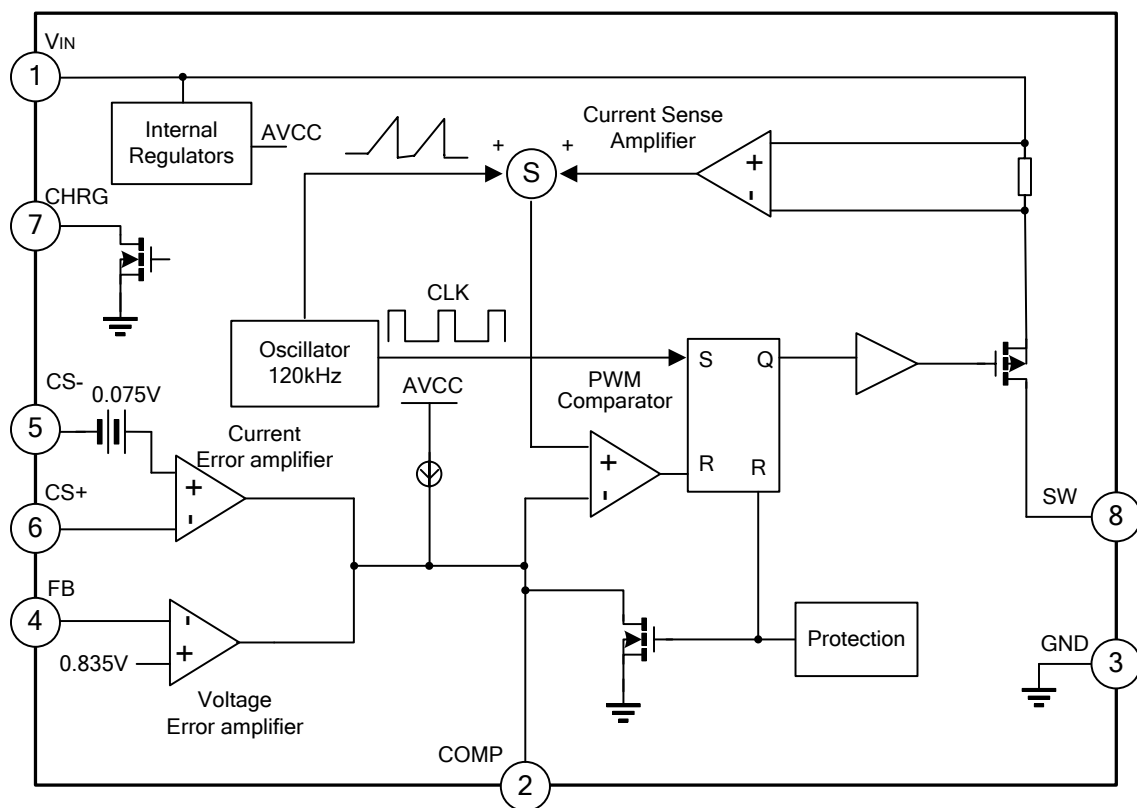
FEATURES

- * Up to 2.1A output current
- * Up to 90% Efficiency
- * Operating voltage can be up to 40V
- * 120 kHz Internal Jitter Frequency for lower EMI
- * Patent -Pending Short Circuit Protection
- * Patent -Pending Output Voltage Compensation
- * Adjustable current limit
- * Over Temperature Protection
- * Small SOP-8 Package

ORDERING INFORMATION

Part No.	Package	Marking	Material	Packing
SD45216JA	ESOP-8-225-1.27	45216JA	Pb free	Tube
SD45216JATR	ESOP-8-225-1.27	45216JA	Pb free	Tape&Reel
SD45216RJA	ESOP-8-225-1.27	5216RJA	Pb free	Tube
SD45216RJATR	ESOP-8-225-1.27	5216RJA	Pb free	Tape&Reel

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_{amb}=25°C)

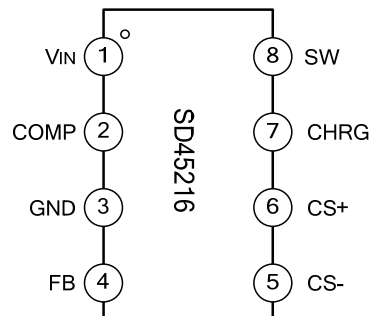
Characteristics	Symbol	Rating	Unit
V _{IN} Supply Voltage	V _{IN}	+42	V
SW Voltage	V _{SW}	-0.3 ~ +42	V
COMP Voltage	V _{COMP}	-0.3 ~ +6	V
FB Voltage	V _{FB}	-0.3 ~ +6	V
CS+ Voltage	V _{CS+}	-0.3 ~ +6	V
CS- Voltage	V _{CS-}	-0.3 ~ +6	V
Open Drain Charge Indication Pin Voltage	V _{CHRG}	-0.3 ~ +6	V
Operating Temperature Range	T _{amb}	-20 ~ + 85	°C
Storage Temperature Range	T _{STG}	-40 ~ +125	°C

ELECTRICAL CHARACTERISTICS (T_{amb}=25°C, V_{IN}=12V, V_{OUT}=5V, Load Current=0 unless otherwise specified)

Characteristics	Symbol	Test condition	Min.	Typ.	Max.	Unit
Operating Voltage	V _{IN}	V _{IN} pin voltage	--	--	40	V
Feedback Reference Voltage	V _{FB}		0.815	0.835	0.855	V
Feedback Current	I _{FB}	V _{FB} =0.81V	--	-0.1	--	μA

Characteristics	Symbol	Test condition	Min.	Typ.	Max.	Unit
Quiescent Current (Switch Off)	$I_{\text{switch off}}$	$V_{\text{FB}} = 1\text{V}$	--	--	3	mA
Quiescent Current (PWM Active Mode)	I_{Q}		--	3	4	mA
Current Sense Offset Voltage	V_{OFFS}		70	75	80	mV
CS+ Pin Bias Current	$I_{\text{CS+}}$	$V_{\text{CS+}} = 5\text{V}$	--	80	100	μA
Efficiency	η	$V_{\text{IN}} = 12\text{V}, V_{\text{OUT}} = 5\text{V}$	--	90	--	%
Switching Frequency	F_{s}	$V_{\text{FB}} = 0.6\text{V}$	100	120	140	KHz
Max Duty Cycle	D_{MAX}	$V_{\text{FB}} = 0.6\text{V}$	--	--	100	%
PMOS Switch On Resistance	R_{ON}		--	0.1	--	Ω
PMOS Switch Leakage	I_{leak}	$V_{\text{SW}} = 0\text{V}$	--	--	10	μA
PMOS Current Limit	I_{LIMIT}		3	3.5	4	A
UVLO Input Rising Voltage	$V_{\text{IN(rising)}}$		7.5	8	8.5	V
UVLO o Voltage Hysteresis	$V_{\text{IN(hyst)}}$		--	1.5	--	V
Open Drain Output Current	I_{OUT}		--	1.5	--	mA
Thermal Shutdown Temperature	$T_{\text{j(sd)}}$		--	150	--	$^{\circ}\text{C}$
Thermal Shutdown Hysteresis	T_{hyst}		--	20	--	$^{\circ}\text{C}$

PIN CONFIGURATION



PIN DESCRIPTION

Pin No.	Pin Name	I/O	Pin Description
1	VIN	P	Input Voltage.
2	COMP	I/O	Frequency compensation, resistor and capacitor connected.
3	GND	G	Ground.
4	FB	I	Feedback Input Pin.
5	CS-	I	Current sense Pins, current limit resistor connected.
6	CS+	I	
7	CHRG	O	Charge indication Open Drain Pin.
8	SW	O	Switch Pin.
EP	Exposed Pad	O	Exposed Pad must be connected with Switch Pin.

FUNCTION DESCRIPTION

The SD45216 is a complete and simple step down DC-DC converter with adjustable current Limit. By means of an on board current sense resistor and the availability of the current sense pins, a current limit programming is very simple and accurate.

Moreover constant current control can be used to charge NiMH and NiCd batteries. The device can be used as a standard DC-DC converter with adjustable current limit (set by using the external sense resistor).

The internal robust PMOS transistor with a typical of 100mΩ assures high efficiency and a minimum dropout even at high output current level. The internal limiting current of typical value of 3.5 A protects the device from accidental overload avoiding dangerous loads damage.

When overload or output short, the main switch is turned off to limit the current delivered to the load for SD45216; while the main switch is turned on and off periodically to reduce the power dissipation for SD45216R; when output short is removed or the load decrease to normal, the output voltage recovers. Both can protect the load and the device itself.

When normal working, the constant current open drain transistor of CHRG is enabled, thus indication is realized by external LED, the constant current typical value is 1.5mA.

If the temperature of the chip goes higher than a fixed internal threshold (150 °C with 20 °C hysteresis), the device is turned off.

The internal fixed switching frequency of 120KHz, and the small ESOP-8 package allow building an ultra compact DC-DC converter with a minimum board space.

APPLICATIONS INFORMATION**Output Voltage And Feedback Loop Settings**

Refer to the figure1, the output voltage of the switching regulator (V_{OUT}) can be set with Equation following:

$$V_{OUT} = (1 + \frac{R3}{R4}) \times 0.835V$$

The limit current is set by the external resistor R2:

$$I_{LIMIT} = \frac{75mV}{R2}$$

The SD45216 uses a patent-pending output voltage compensation scheme for the conductor wire loss by properly selecting the value of R3、R4, if the conductor resistance is Rline, current sense resistor is R2 (Refer to the figure1), then:

$$R3 = \frac{Rline}{160\mu \cdot R2}$$

$$R4 = \frac{0.835 \cdot R3}{V_{OUT} - 0.835}$$

For Rline=50mΩ, R2=33.3mΩ (2.25A current limit as figure 1), V_{OUT} =5V; R3=9.4k, R4=1.9k, choose R3=10k, R4=2k as the figure1.

Component Selection

✧ Inductor Selection

The SD45216 can utilize small inductors due to its fast 120kHz switching frequency. Typically, a 100 μ H inductor is recommended for most applications. Larger values of inductance will allow greater output current capability by reducing the inductor ripple current. Increasing the inductance above will also increase size.

The inductor current ripple is typically set for 20% to 40% of the maximum inductor current (IP). The inductor should have low ESR (series resistance of the windings) to reduce the power losses, and must be able to handle the peak inductor current without saturating. To minimize radiated noise, use a shielded bobbin inductor.

✧ Output and Input Capacitor Selection

Low ESR (equivalent series resistance) capacitors should be used to minimize the output voltage ripple. The parallel of multilayer ceramic and electrolytic capacitors is an excellent choice as they have extremely low ESR and are low cost. A parallel of 10 μ F ceramic capacitor and 470 μ F electrolytic capacitor is sufficient for most applications. Larger values may be used to obtain extremely low output voltage ripple and improve transient response.

Low ESR input capacitors reduce input switching noise and reduce the peak current drawn from the battery. It follows that ceramic capacitors are also a good choice for input decoupling, and should be located as close as possible to the device.

A 10 μ F input capacitor is sufficient for virtually any application. For all the ceramic capacitors above, X5R and X7R dielectric materials are preferred, for their ability to maintain capacitance over wide voltage and temperature ranges.

TYPICAL APPLICATION CIRCUIT

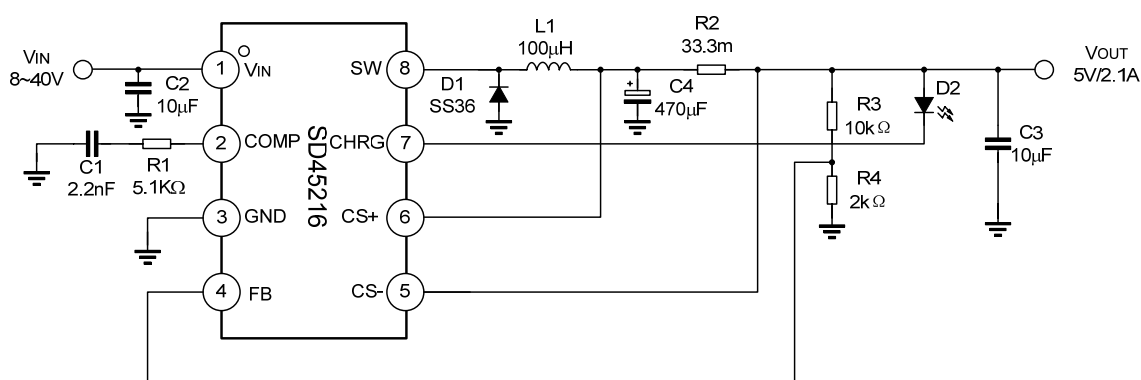


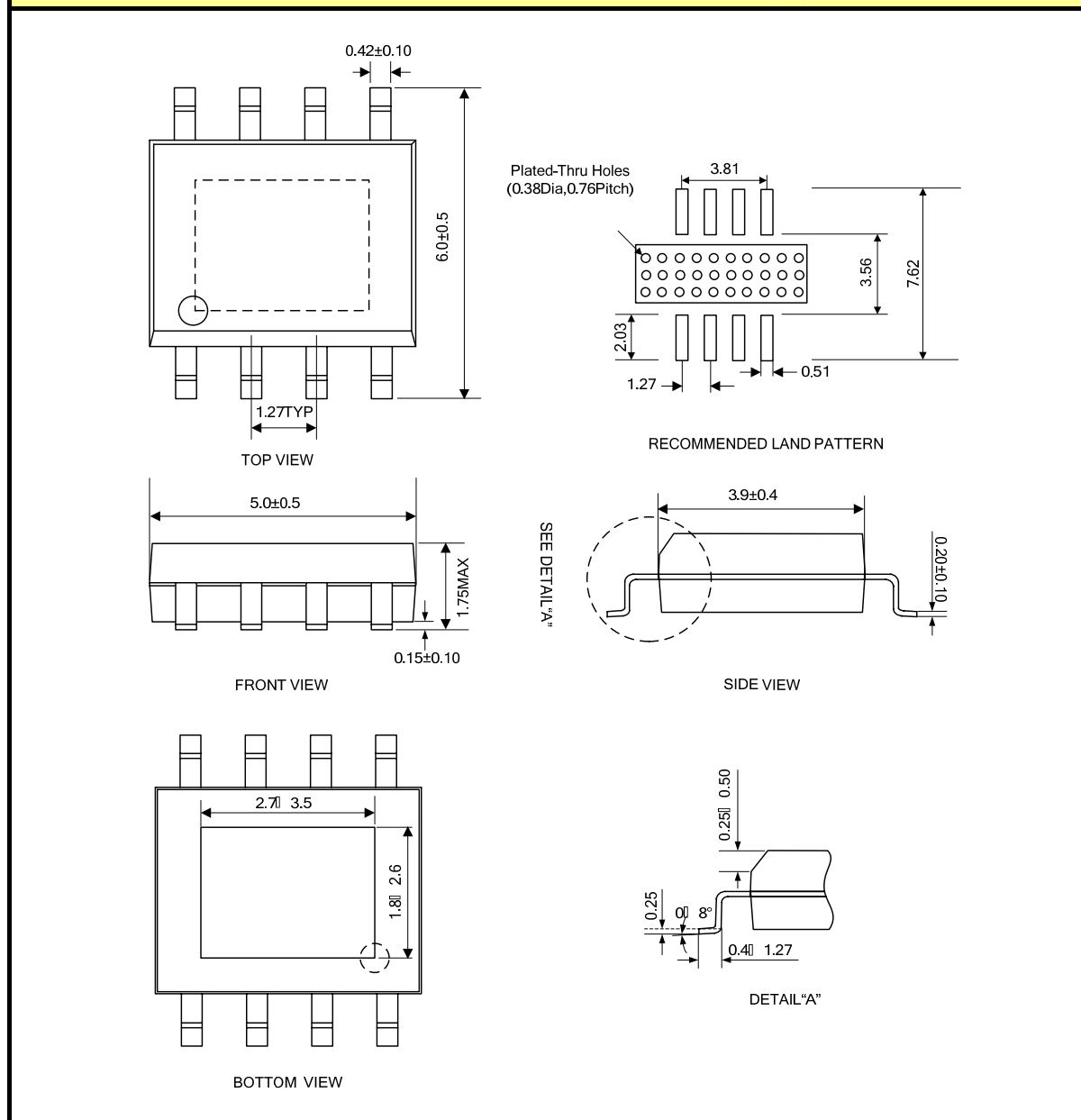
Figure 1. Application Circuit for 5V/2.1A Output (2.25A Current Limit)

Note: The circuit and parameters are reference only, please set the parameters of the real application circuit based on the real test.

PACKAGE OUTLINE

ESOP-8-225-1.27

UNIT: mm



Note:

Please soldering together of PCB copper foil and pad which is at the bottom of ESOP package, and enlarge copper foil on PCB for heat dissipation. Better for more plated-thru holes on PCB attached to PAD.

**MOS DEVICES OPERATE NOTES:**

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

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ATTACHMENT**Revision History**

Date	REV	Description	Page
2010.10.27	1.0	Original	
2011.04.29	1.2	Modify" DESCRIPTION", "FEATURES", "ORDERING INFORMATION", "ABSOLUTE MAXIMUM RATINGS", "ELECTRICAL CHARACTERISTICS", "APPLICATIONS INFORMATION", "TYPICAL APPLICATION CIRCUIT", "PACKAGE OUTLINE"	
2011.07.04	1.4	Modify the "FEATURES", "ORDERING INFORMATION", "BLOCK DIAGRAM", "ELECTRICAL CHARACTERISTICS", "FUNCTION DESCRIPTION"	
2011.11.18	1.6	Modify the "DESCRIPTION", "ELECTRICAL CHARACTERISTICS", "FUNCTION DESCRIPTION"	