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

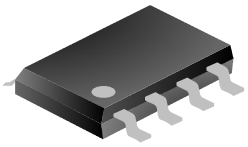
DESCRIPTION

The SD45215 is a high efficiency step down DC-DC converter with adjustable current limit in compact SOP-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 150 mΩ assures high efficiency even at high output current level. The internal limiting current of typical value of 3 A, output short and over temperature protection, protect the device from accidental damage.

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



SOP-8-225-1.27

APPLICATIONS

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

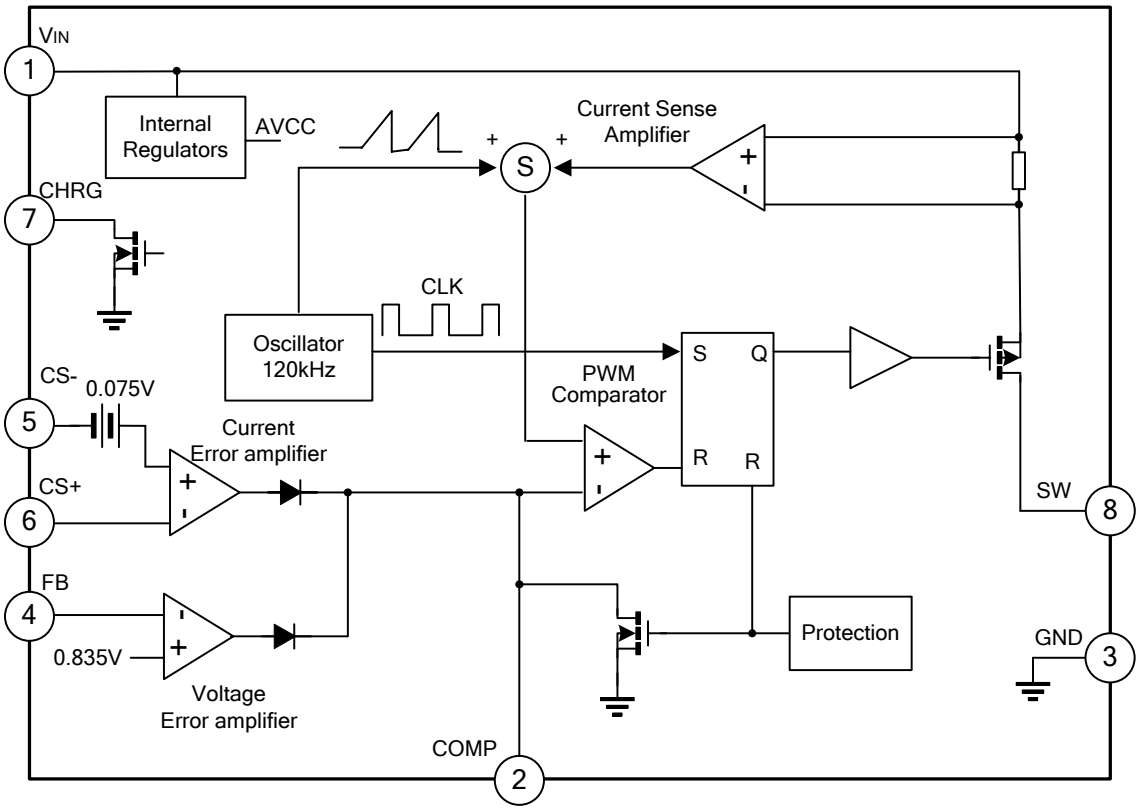
FEATURES

* Up to 1.5A output current
* Up to 90% Efficiency
* Input Voltage Range: 8V to 30V
* 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
SD45215SA	SOP-8-225-1.27	45215SA	Pb free	Tube
SD45215SATR	SOP-8-225-1.27	45215SA	Pb free	Tape&Reel

BLOCK DIAGRAM



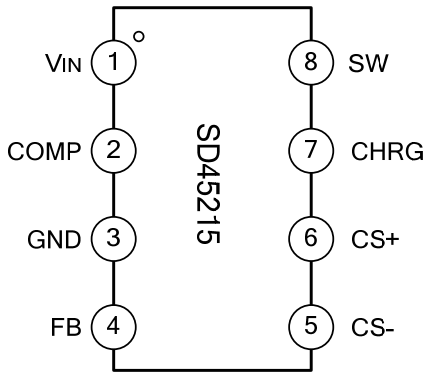
ABSOLUTE MAXIMUM RATINGS (Tamb=25°C)

Characteristics	Symbol	Rating	Unit
VIN Supply Voltage	V_{IN}	+32	V
SW Voltage	V_{SW}	-0.3 ~ +32	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
Input Voltage Range	V_{IN}	V_{IN} pin voltage	8	--	30	V
Feedback Reference Voltage	V_{FB}		0.815	0.835	0.855	V
Feedback Current	I_{FB}	V_{FB}=0.81V		-0.1		μA
Quiescent Current (Switch Off)	$I_{switch\ off}$	V_{FB} =1V			3	mA
Quiescent Current (PWM Active Mode)	I_Q			3	4	mA
Current Sense Offset Voltage	V_{OFFS}		70	75	80	mV
Efficiency	η	V_{IN}=12V, V_{OUT}=5V		90		%
Switching Frequency	F_s	V_{FB} =0.6V	100	120	140	KHz
Max Duty Cycle	D_{MAX}	V_{FB} =0.6V			100	%
Pmos Switch On Resistance	R_{ON}			0.15		Ω
Pmos Switch Leakage	I_{leak}	V_{SW}＝0V			10	μA
Pmos Current Limit	I_{LIMIT}		2.5	3	3.5	A
UVLO Input Rising Voltage	$V_{IN(rising)}$		7.8	8	8.2	V
UVLO o Voltage Hysteresis	$V_{IN(hyst)}$			1.5		V
Open Drain Output Current	I_{OUT}			1.5		mA
Thermal Shutdown Temperature	$T_{j(sd)}$	--	--	150	--	°C
Thermal Shutdown Hysteresis	T_{hyst}	--	--	20	--	°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.

FUNCTION DESCRIPTION

The SD45215 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 150 mΩ assures high efficiency and a minimum dropout even at high output current level. The internal limiting current of typical value of 3 A protects the device from accidental overload avoiding dangerous loads damage.

When overload or output short, the main switch is turned off, thus the current offered to the load is limited, protecting the load and the device also.

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 SOP-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:

$$V_{OUT} = (1 + \frac{R3}{R4})X0.835V$$

The limit current is set by the external resistor R2:

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

The SD45215 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=80mΩ, R2=50mΩ (1.5A current limit as figure 1), V_{OUT}=5V; R3=10k, R4=2k, as the figure1.

Component Selection

✧ **Inductor Selection**

The SD45215 can utilize small inductors due to its fast 120kHz switching frequency. Typically, a 100μH 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 10μF ceramic capacitor and 470μF 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 10μF 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

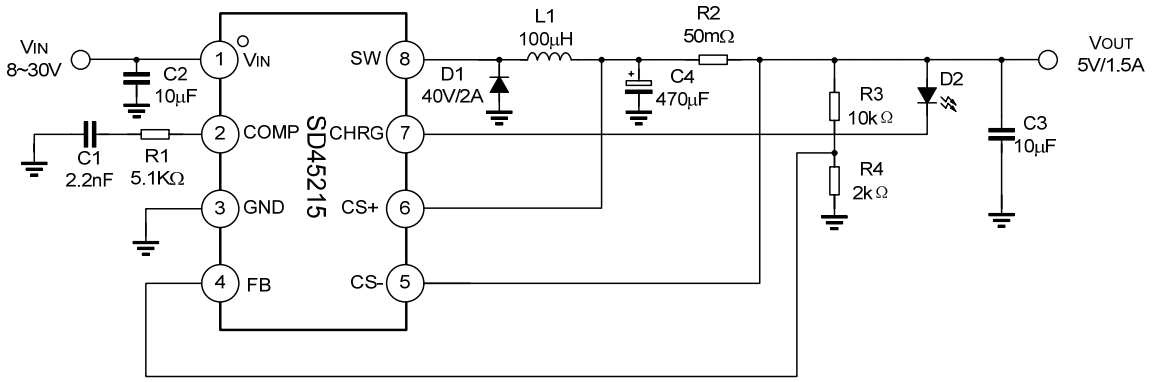
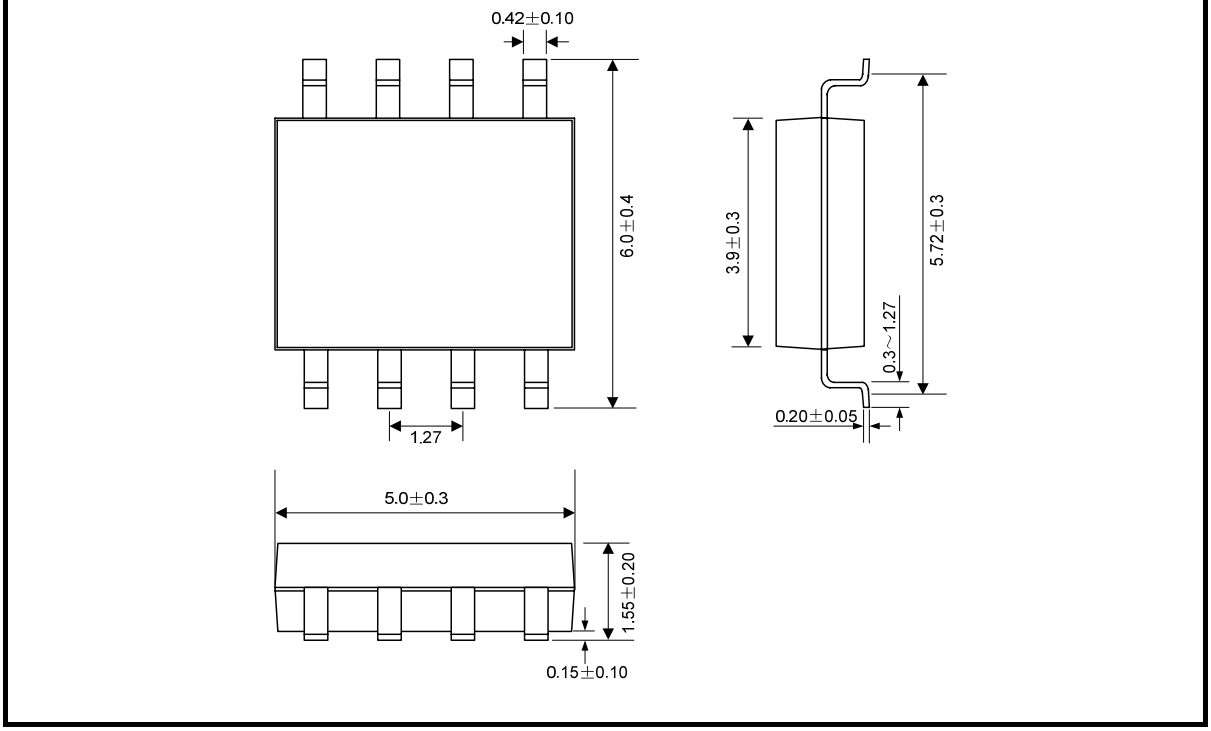


Figure 1. Application Circuit for 5V/1.5A Output

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

PACKAGE OUTLINE

SOP-8-225-1.27 UNIT: mm



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.

ATTACHMENT

Revision History

Date	REV	Description	Page
2010.09.14	1.0	Original	
2010.10.20	1.1	Modify the template of Datasheet	
2011.04.21	1.3	Modify “FEATURES”, “ORDERING INFORMATION”, “ABSOLUTE MAXIMUM RATINGS”, “ELECTRICAL CHARACTERISTICS”, “APPLICATIONS INFORMATION ”, “TYPICAL APPLICATION CIRCUIT”, “PACKAGE OUTLINE”	